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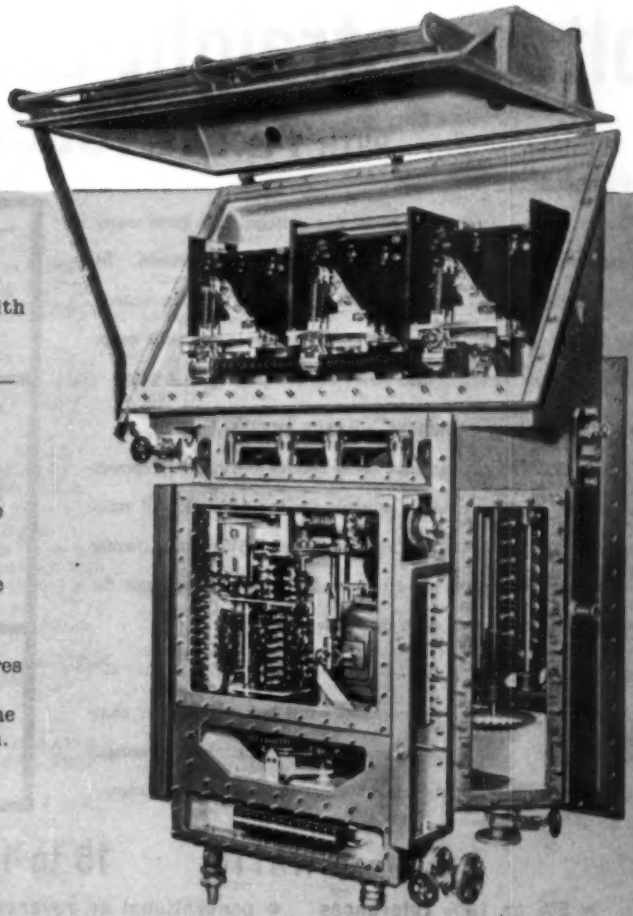

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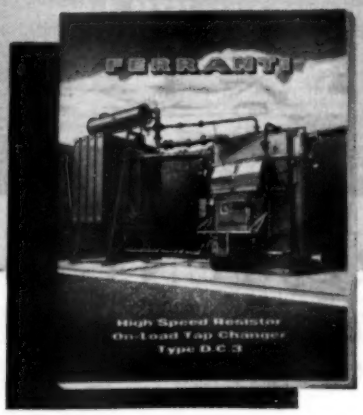

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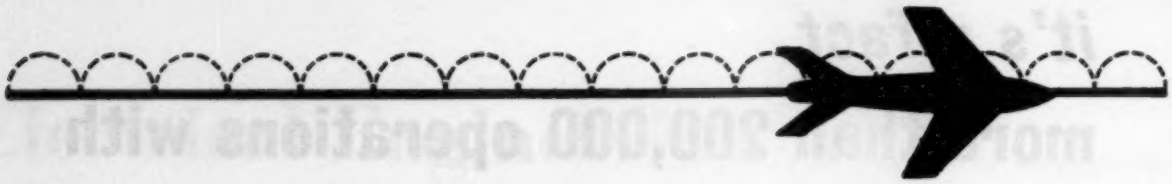

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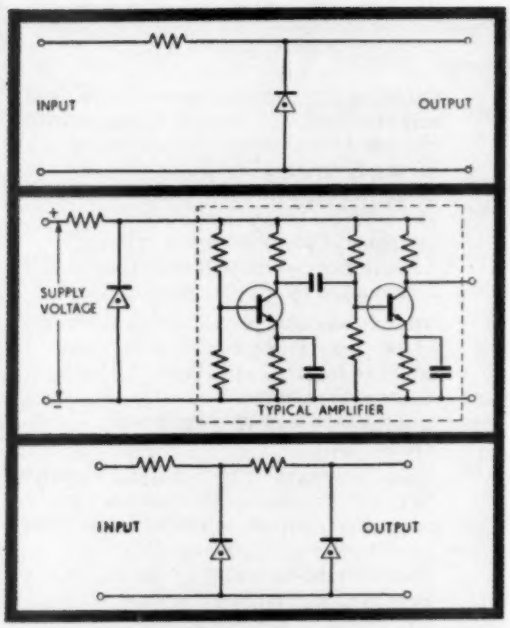

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ELECTRICAL ENGINEERING ABSTRACTS

Volume 63 **APRIL 1960** **Number 748**

GENERAL

(For abstracts on circuit theory see also Lines . Networks . Filters)

614.825

1971 MINING ELECTRICAL ACCIDENTS AND DANGEROUS OCCURRENCES DURING 1958 AND SUGGESTED PREVENTIVE MEASURES. J.Cowan.
Mining elect. mech. Engr, Vol. 40, 247-56 (Feb., 1960).

621.3

1972 ANNUAL REVIEW OF PROGRESS. SOME DEVELOPMENTS AND ACHIEVEMENTS DURING 1959.
B.T.-H. Activ., Vol. 30, No. 7, 257 (Jan.-Feb., 1960).

621.3.011.1

1973 A STUDY OF NON-POTENTIAL ELECTRIC FIELDS. M.P.Zhatev.
Rev. gen. Elect., Vol. 68, No. 9, 555-9 (Sept., 1959). In French.

The object is to develop a simple relationship between the E and H vectors which is valid for any quasi-stationary variation of B with time. This relationship is derived in terms of a parametric vector whose definition is analogous to the Biot–Savart–Laplace law.
V.G.Welsby

621.3.012.8 : 621.314.25

CALCULATION OF CIRCUITS WITH RECTIFIERS AND ACTIVE RESISTANCES. See Abstr. 1218

621.3.013.2

1974 FLUX DISTRIBUTION IN A PERMEABLE SHEET WITH A HOLE NEAR AN EDGE. B.V.Jayawant.
Proc. Instn Elect. Engrs, Monogr. 368 M, publ. March, 1960. 4 pp. To be republished in Pt C.

In the measurement of the distribution of magnetic flux in the cores of electrical machines by locating search coils in them, the presence of a search-coil will alter the flux in that region. It is therefore necessary to make a correction to the measured flux. The problem is the solution of Laplace's equation in two dimensions in a material assumed to be of constant permeability, and it has an analogy in hydrodynamics. The solution is obtained by a conformal transformation; it is found that the correction is quite significant when the distance of the centre of the hole from the edge is equal to its diameter.

POWER RESOURCES
PRIME MOVERS

620.9 : 621.362

THERMOELECTRON ENGINES: FUTURE POWER SOURCES? See Abstr. 1474

620.91

1975 HYDRO-ELECTRIC DEVELOPMENT IN PEOPLE'S CHINA. J.Chenais.
Houille blanche, Vol. 14, No. 4, 439-49 (July, 1959). In French.

620.91

1976 THE HYDRO-ELECTRIC RESOURCES OF PERU. M.Mary.
Houille blanche, Vol. 14, No. 4, 450-6 (July, 1959).

620.92

1977 HYDRO-ELECTRIC POTENTIAL IN SWEDEN. T.Berglund and S.O.Larsson.
Water Pwr, Vol. 11, No. 11, 415-18 (Nov., 1959).

The gross potential has recently been re-evaluated by two methods, one taking each part of the watershed separately, and the other (recommended by E.C.E.) based on the mean flow originating in an area and its height above sea level. The total annual potential is estimated at 200×10^9 kWh.
P.Linton

620.92

1978 SOME ECONOMIC ASPECTS IN CONNECTION WITH THE CO-ORDINATION AND PLANNING OF THE RESOURCES OF ELECTRICAL ENERGY IN PORTUGAL.
F.Ivo Gonçalves, S.Pais and J.Cruz Morais.
World Power Conference, Canadian Sectional Meeting, (Montreal, 1958) Section A_2 Paper 97 $A_2/9$, 17 pp. In French.

The principal source of electricity in Portugal is water power and special methods, such as large inter-connected reservoirs and pumped storage, are being adopted to overcome its irregularity. The aim of the new planning of resources which began in 1951 is to effect a satisfactory compromise between economic operation and continuity of supply. Schemes are operated by private companies, but the network is co-ordinated on a national basis. As the country is poor in coal, most of the thermal power stations burn imported coal and are used only in very dry periods. Atomic energy is being studied and will be incorporated into the system at a favourable opportunity. It is expected that a small experimental atomic power station, although it will not be justified technically or economically, will be put into operation within ten years. When atomic energy can compete in cost with conventional sources of energy and at the same time be suitably combined with the rest of the system, the plan will certainly be greatly modified.
E.W.Golding

621.039 : 621.387 : 539.17

1979 THE BASIC PHYSICS OF THERMONUCLEAR PROCESSES. T.E.Allibone and D.R.Chick.
Proc. Instn Elect. Engrs, Paper 2888 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 3-11, 43-6).
Republication, with discussion, of the paper abstracted in Abstr. 2577 (1959).

621.039

1980 THE DR2 EXPERIMENTAL REACTOR. K.O.Nielsen.
Ingeniøren B, Vol. 68, No. 24, 720-6 (Dec. 15, 1959). In Danish.

The reactor, Danish built following an American Foster–Wheeler design, became critical in Dec. 1958 after which a series of low-power tests over 8 months were carried out. The DR2 is a light-water moderated and cooled heterogeneous reactor of the tank type with 5 MW output using highly enriched uranium. The reactor hall is built as a cylindrical steel tank of 25 m dia., 24.5 m in height. The construction of the reactor and its cooling and regulating systems are described in detail. It is provided with 9 watertight test channels which pass through the screen and tank wall to the core and down which probes can be inserted for nuclear measurement purposes. The future experimental programme is outlined.
G.N.J.Beck

621.039 : 621.387 : 537.52 : 539.17

1981 THE DESIGN AND PERFORMANCE OF ZETA. E.P.Butt, R.Carruthers, J.T.D.Mitchell, R.S.Pease, P.C.Thonemann, M.A.Bird, J.Blears and E.R.Hartill.
Proc. Instn Elect. Engrs, Paper 2901 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 12-29, 43-6).
Republication, with discussion, of the paper abstracted in Abstr. 2578 (1959).

621.039 : 656.57 : 537.525 : 539.17

1982 THE MODIFICATION OF ZETA IN 1956. J.T.D.Mitchell, H.R.Whittle, E.M.Jackson and P.B.Clarke.
Proc. Instn Elect. Engrs, Paper 2930 [Convention on Nuclear Processes] publ. April, 1959 (Vol. 106A, Suppl. No. 2, 74-81, 82-5, 1959).
Republication, with discussion, of the paper abstracted as Abstr. 2582 (1959).

621.039 : 621.387 : 537.52

1983 CHOICE OF MATERIALS AND PROBLEMS OF DESIGN OF HEAVY-CURRENT TOROIDAL DISCHARGE TUBES. A.E.Robson and R.Hancox.
Proc. Instn Elect. Engrs, Paper 2948 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 47-55, 82-4).
Republication, with discussion, of the paper abstracted in Abstr. 2583 (1959).

621.039 : 537.534 : 539.17

1984 STUDIES OF TRAPPING FAST CHARGED PARTICLES IN A CONSTANT MAGNETIC FIELD. I.N.Golovin.
Proc. Instn Elect. Engrs, Paper 3030 [Convention on Thermonuclear Processes], Vol. 106 A, Suppl. No. 2, 95-9 100 (1959).
Outlines the principles of, and experimentation connected with, O.G.R.A., the molecular ion injection mirror machine at the Atomic Energy Institute, Moscow. Trajectories of the molecular ion beam have been observed and methods of increasing the path-length to the design figure of 1 km are described. Experimental confirmation of adiabatic trapping has been obtained by measuring the life-times of trapped β-particles produced by the decay of tritium in a small mirror machine. The life-time was measured from the ionization produced, as a function of tritium pressure, mirror ratio and azimuthal symmetry of the magnetic field. The maximum number of mirror reflections observed exceeded 10^7. Non-adiabatic losses were observed, particularly with azimuthal asymmetry present.
R.S.Pease

621.039 : 621.3.016

1985 ENERGY STORAGE FOR THERMONUCLEAR RESEARCH. R.Carruthers.
Proc. Instn Elect. Engrs, Paper 2915 [Convention on Thermonuclear Processes] publ. April, 1959 (Vol. 106A, 166-72, 182-5).
Republication, with discussion, of the paper abstracted as Abstr. 2581 (1959).

621.039 : 621.387 : 537.56 : 539.17

RAPID HEATING FOR CONTROLLED FUSION RESEARCH.
See Abstr. 1711

621.221

1986 PRINCIPLES OF POWER BALANCE CALCULATIONS FOR ECONOMIC PLANNING AND OPERATION OF INTEGRATED POWER SYSTEMS. K.Darin, Y.Larsson, C.E.Lind, J.E.Ryman and B.Sjölander.
Svenska Vattenkr.Fören. Publ. No. 476 (1959: No. 11) 317-83.
The use of hydrological statistical data for power balance calculation is discussed with reference to the collection of data in punched card and punched tape form. The method for determining the basic rule curve, involving the calculation of the minimum zone of storage reservoirs in then explained, and its application to the following hydro-electric systems is considered: single storage reservoir and single hydro-electric station system, using both unregulated river flow, storage reservoirs in unregulated lakes, system comprising several reservoirs with different degrees of regulation, and system comprising some reservoirs having a low degree of regulation. Availability of supply and its economic aspects are then considered, dealing with optimum availability, recommended availability factor and rationing conditions below the basic rule curve. Chapters also deal with the distribution of draw-down among various storage reservoirs and the calculation of overflow risk.
G.N.J.Beck

621.221

1987 TRENDS AND POSSIBILITIES IN THE GENERATION OF HYDRO-POWER IN WESTERN EUROPE. M.C.Marcello.
World Power Conference, Canadian Sectional Meeting, (Montreal, 1958), Section A_2, Paper 122 $A_2/6$, 22 pp. In French.
The demand for electricity in Europe is steadily increasing and will probably increase still more with the development of nuclear energy, which can be best used in the form of electricity. It is estimated that in 1975 the production of electricity in the O.E.E.C. countries will be 43% of the total production of energy, whereas in 1955 it was 22% and in 1949 only 17%. In the near future supply will principally be given by conventional fuels, but hydro-power is still important and could be further exploited. Solid-fuel production is not readily adaptable to meet the peak load and nuclear production even less so. Hydro-power could be used for this purpose as well as to supply the base load. Large inter-connected schemes are recommended with reservoirs and pumped storage to regulate the daily, weekly and seasonal fluctuations and to increase the ratio of installed capacity to energy generated. Such schemes are already projected or in existence in parts of Central Europe.
E.W.Golding

621.221

1988 LAKE REGULATION AND RESERVE POWER. Y.Larsson.
Svenska Vattenkr.Fören. Publ. No. 475 (1959:8) 271-310. In Swedish.
The 'security' of power supply is discussed in relation to the minimum zone of the reservoir, which is defined as the percentage capacity that together with thermal production is sufficient to cover peak loads. It is dependent upon winter inflow to the reservoir, the unregulated hydro-power generated in the system during winter, time of start of spring flood, size of load, possible thermal power generation. The rise in costs due to an increased supply security is shown. To obtain 95-99% security, a thermal power supplement of 35-55 kW per MkW load is required. Optimum reservoir size is discussed. The optimum degree of regulation lies between 40 and 50%, and under specially favourable conditions 60% may be achieved. No reservoir with ordinary installation costs should have higher than 80-90% degree of regulation.
G.N.J.Beck

POWER SUPPLY
POWER STATIONS

621.311.1

1989 CHOICE OF ELECTRICAL PARAMETERS FOR ELECTRICAL EQUIPMENT AND DRIVE IN AN ENERGY SYSTEM. I.A.Syromyatnikov.
Elektrichestvo, 1959, No. 10, 1-8 (Oct.). In Russian.
Discusses the economics of generators, motors, transformers etc., viewing the energy system within the framework of the national economy as a whole. Some typical results are obtained, applicable to the U.S.S.R. but not, for example, to the U.S.A. Factors such as reliability and life of equipment etc., as well as operational efficiency, are taken into account.
D.E.Brown

621.311.1 : 681.142

ITERATION METHODS FOR DIGITAL LOAD FLOW STUDIES.
See Abstr. 1941

621.311.153 : 621-52

THE POSSIBILITIES AND OBSTACLES IN THE AUTOMATIC CONTROL OF THE HEAT BALANCE OF A BOILER PLANT.
See Abstr. 1916

621.311.154 : 681.142

1990 A NEW DIGITAL TRANSIENT STABILITY PROGRAM. M.S.Dyrkacz and D.G.Lewis.
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 913-19 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).
A programme for an I.B.M. 704 computor produces swing curves for each synchronous machine in a power network containing up to 48 machines, 200 busses and 350 lines; any sequence of symmetrical faults, line clearings, or other symmetrical switching operations may be specified. The general procedure is similar to that employed with an a.c. network analyser and starts from a load flow balance, obtained digitally. The programme computes the voltages behind generator transient reactances and stores them as fixed in magnitude but with their angles permitted to change. Fixed impedances corresponding to the various loads are computed, the correct network changes corresponding to the application of a fault are then made, and the power output of each machine determined by a nodal iterative method. A sample calculation for 16 generators, 71 busses and 89 lines took just over 16 minutes computor time.
G.A.Montgomerie

621.311.154 : 681.142

1991 CALCULATION OF ECONOMIC LOAD DISTRIBUTION BY COMPUTERS. T.Vámos and L.Borovszky. Elektrotechnika, Vol. 52, No. 8-9, 358-68 (Aug.-Sept., 1959). In Hungarian.

A survey is given of the basic principles of determining conditions for economic load distribution. Basic equations are treated for methods based on different principles. Practical computers are discussed with particular reference to system conditions in Hungary. L.Csuros

621.311.154 : 681.142

1992 DIGITAL COMPUTATION OF POWER FLOW — SOME NEW ASPECTS. H.W.Hale and R.W.Goodrich. Trans Amer. Inst. Elect. Engrs III, Vol. 78, 919-24 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

The nodal method of calculating power flow is often based on defining the network by the use of driving-point and transfer admittances. It would also be possible to use the driving-point and transfer impedances but the sample problem solved by the previous method in 54 iterations proved insoluble. However, both methods may be regarded as special cases of a more general method, the transfer-ratio method, in which some terminal pairs are associated with driving-point and transfer admittances and the others with driving-point and transfer impedances. The matrix equation defining the network then contains also a set of current transfer ratios and a set of voltage transfer ratios. In the example, by using this method, the number of iterations was reduced to 10 at the expense of an increased data preparation time. G.A.Montgomerie

621.311.21

1993 GENERATOR/MOTOR PROBLEMS. MACHINES FOR PUMPED STORAGE SCHEMES. J.H.Walker. Elect. Rev., Vol. 165, No. 9, 411-17 (Oct. 9, 1959).

The problems raised by 100-200 MVA pumped-storage sets are discussed. The extra cost of 2-speed machines suitable for driving a pump-turbine is in doubt. Methods of starting and coupling sets with separate turbine and pump are discussed and a separately-driven fan is shown to be more economical for reversible machines. The advantages of dynamic braking in certain cases are outlined. P.Linton

621.311.21

1994 SLUICE GATES FOR POWER STATIONS. DEVELOPMENT TRENDS. H.Heligren. Svenska VattenkrFören. Publ., No. 477 (1959: No. 12), 417-22. In Swedish.

Design has tended towards greater manoeuvrability of gates. The equipments are assembled in relatively large units at the factory to facilitate assembly on site. Mechanical and hydraulic drives and chute intake arrangements are discussed. A short account is given of the sluice and crane installation at the power station on the Assuan dam. G.N.J.Beck

621.311.21

1995 OLIVER DAM HYDROELECTRIC PLANT ELECTRICAL DESIGN. R.J.Kelly. Trans Amer. Inst. Elect. Engrs III, Vol. 78, 931-37 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

The dam on the Chattahoochee (U.S.A.) is a concrete gravity structure 80 ft high and 2021 ft long. The run-of-river station comprises 3 propeller turbines operating at 150 rev/min under 68 ft head and driving 22.5 MVA 7.6 kV alternators. A fourth turbine to utilize low river flow drives a 7.5 MVA 257 rev/min 7.6 kV alternator. Three transformers connect to the 115 kV substation where an oil-circuit-breaker controls the 4 mile wooden-pole transmission line to the nearest grid tie point. The station is of the outdoor type and the units can be serviced by outdoor crane. The station is controlled from Bartletts Ferry hydroelectric station over a telephone circuit. P.Linton

621.311.21

1996 ASCHACH STATION. E.Königshofer. Water Pwr, Vol. 11, No. 12, 466-71 (Dec., 1959).

This is the third station on the Austrian Danube, immediately below Jochenstein. The concrete dam incorporates twin locks 24 × 230 m, a spillway with 5 hook gates, and the power house with 4 Kaplan turbines rated at 1800 m^3/sec (the 91 day flow). The 72 MW 15 kV alternators are connected to 220 kV transformers, the output being transmitted by oil-filled cables to the substation on the river bank. Two existing power stations on tributaries will be affected by the backwater. P.Linton

621.311.22

1997 ELECTRONIC BOILER CONTROL AT LITTLE BARFORD "B" POWER STATION. Engineer, Vol. 209, 226-9 (Feb. 5, 1960).

The first electronic system of automatic boiler control in a C.E.G.B. power station is in operation at Little Barford "B" power station, near St. Neots. The generating plant consists of two Foster-Wheeler 550 000 lb/hr (c.m.r.), p.f. fired, outdoor boilers supplying steam at 900 lb/in^2 and 900 deg Fah. to two 60 MW Parsons turbo-alternators. Each boiler/turbo-alternator set operates as a unit with a cooling tower. Boiler combustion conditions are controlled automatically to match steam demand by the Evershed and Vignoles electronic system based on the use of transmitters, simple analogue computers and three-term controllers operating valve and damper positioners.

621.311.22

1998 SOME HIGH SPOTS IN THERMAL POWER GENERATION. B.Wood. Engineer, Vol. 209, 250-3 (Feb. 12); 290-6 (Feb. 19, 1960).

A topical survey of developments in large steam power plant with comments on highest points achieved in turbines and boilers at present ordered. Comments are made on trends, limitations, prospects and economic aspects. Stress is laid on the importance of choice of speed of turbines as affecting exhaust arrangement in view of the more easily won gains at the low temperature end of the cycle. A world list of outstanding units in point of size, temperature or pressure is given. Mention is also made of gas turbines.

621.311.22

1999 THE NEW HAMBURG-WEDEL POWER STATION. R.Meister. Brennstoff-Wärme-Kraft (B.W.K.), Vol. 11, No. 8, 385-90 (Aug., 1959). In German.

This power station, on the lower Elbe, will have a final capacity of 500 to 550 MW. The first turbo-alternator set (125 MW) has been designed for 2560 lb/in^2 and 995/995° F. The heat consumption at optimum load is expected to be 8750 B.t.u./kWh. After a general survey of the overall planning, the thermal cycle, turbines and steam generators, as well as the auxiliaries and civil engineering aspects are described. In addition, the coal and oil handling plant are mentioned as the power station is located near water deep enough for ocean-going ships. The first stage is expected to be commissioned in autumn, 1961.

621.311.22

2000 DRAKELOW "B" POWER STATION. Elect. Rev., Vol. 165, No. 19, 869-77 (Dec. 18, 1959).

The first of the 4 sets of this station on the river Trent has been commissioned. The single-drum reheat boiler produces 860 000 lb/h steam at 1500 lb/in^2 and 1000° F. The 3-cylinder impulse reaction turbine has a double-flow l.p. cylinder; it runs at 3000 rev/min and drives a 120 MW 13.8 kV hydrogen-cooled alternator. The 3-ph. transformer is connected by oil-filled cables to the 275 kV 7500 MVA airblast switchgear. Pairs of units are run by a unit control room while the main control room supervises both A and B station. P.Linton

621.311.22

2001 AUXILIARY SYSTEM FOR A SUPERCRITICAL UNIT. A DESIGN BASED ON A TESTED SYSTEM FOR A SUBCRITICAL UNIT. J.P.Fitzgerald, C.F.Paulus and H.A.Vargas. Trans Amer. Inst. Elect. Engrs III, Vol. 78, 878-85 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

The design of an auxiliary system for a large supercritical pressure unit based on a tested system used for very large subcritical units at present in service is considered. Special emphasis is placed upon developing the principles governing automatic transfer following a unit tripoff. Methods of calculation are developed to determine critical transfer times. These are verified by a full-scale test. G.V.Hargreaves

621.311.22

2002 MARCHIENNE-AU-PONT ELECTRIC POWER STATION OF THE SOCIÉTÉ COOPERATIVE MIXTE DE PRODUCTION D'ÉLECTRICITÉ "INTERSAMBRE".
E.Maryssael and M.Simonart.
Votre Electricite, Vol. 30, 10-32 (Dec., 1959). In French.

A detailed illustrated description of this power station which constitutes one of the most important units of electrical energy production in Belgium. According to the original plan three 27 MW sets were to be provided but two of these sets have not been installed and have now been replaced by a monobloc set of 115 MW. A special feature of the plant is the coal storage and handling system. This consists of a semicircular yard of 150 m diam. served by a portico bridge supported at the centre by a fixed pillar while the outer pillar is mounted on a truck moving on a circular track. The storage capacity is 90 000 t. The coal is pulverized in three pendulum breakers. The boiler, for a vaporization of 350 t/h, is of the radiation type with natural circulation. The superheated steam has a temperature of 540°C and a pressure of 131 kg/cm². The Rateau-type turbine consists of a high-press. stage, a medium-press. stage, and a three-section low-press. stage. Three outlets lead to the condensing plant. 7 bleeders supply steam for the reheaters. The alternator is hydrogen-cooled. With air-cooling the output is 65 MVA; with hydrogen of 2 kg/cm² pressure it is 154 MVA. The alternator voltage of 15 kV is stepped up by an en bloc-connected transformer to 150 kV, and transmitted by a 12 km overhead line to an important substation at Gouy of the 150 kV grid. Switching and protective gear are arranged partly in an outdoor installation, partly in the control and regulating room. R.Neumann

621.311.22 : 621-52

LITTLE BARFORD "B", ELECTRONIC BOILER-CONTROL. See Abstr. 1917

621.311.23 : 621.398

2003 REMOTELY CONTROLLED POWER STATION.
Elect. Rev., Vol. 165, No. 19, 897-8 (Dec. 18, 1959).

A 3 MW gas-turbine driven peak-load generator has been installed at Princetown (Devon). A Proteus engine drives the 11 kV alternator at 1000 rev/min through an epicyclic reduction gear. Low weight and absence of vibration reduce the building costs. The set is operated remotely from the Bristol control room over public telephone lines; after a machine fault the control gear rings the telephone operator, requests connection with the control room and announces its identity, after which all control facilities are available. P.Linton

621.311.25

2004 HALLAM NUCLEAR POWER STATION IN NEBRASKA.
Engineer, Vol. 209, 320-4 (Feb. 19, 1960).

The plant will employ the sodium–graphite reactor, which offers the advantage of producing steam conditions comparable to modern steam power generation practice. The Hallam station will produce 75 MW (electrical) using steam at 800 lb/in.² and 825 deg Fah. The reactor will use uranium dioxide as fuel, graphite as moderator, and sodium as the heat transfer fluid. The plant will operate with higher reactor coolant temperatures, higher fuel-element surface-temperatures and higher steam pressure and temperature than any other reactor under construction in the American Demonstration Power Reactor programme.

621.311.26

2005 IMPROVEMENT OF THE EFFICIENCY OF THERMAL POWER STATIONS BY THE APPLICATION OF THE MIXED GAS-STEAM CYCLE WITH FREE-PISTON GENERATORS.
H.Horgen and P.Szereszewski.
World Power Conference, Canadian Sectional Meeting, (Montreal, 1958), Section $B_4/3$, Paper 18 $B_4/3$, 21 pp. In French.

The combined gas-steam cycle has the advantages of increased installed capacity, increased overall efficiency and flexibility of operation. It can be used either for the production of electricity alone or for the simultaneous production of electricity and process steam. There are three principal types of installation used for the production of electricity: those with an overfed boiler, placed above the gas turbine; those with a normal boiler, at atmospheric pressure, placed below the gas turbine; those in which the gases, before entering the gas turbine, are used to superheat the steam cycle. The addition of a gas turbine with free-piston generators to an existing steam installation increases the overall efficiency of the two sets, but, if the efficiency of the steam installation is relatively low, the overall efficiency may be less than that of the gas turbine itself. In new installations, the efficiency of a combined gas-steam cycle depends on the nature of the steam cycle and on the method of combining the steam set with the gas set. A combined gas-steam cycle with free-piston generators is 4.8% more economic than that with a rotary compressor. For the simultaneous production of electricity and process steam, various methods of combining gas and steam turbines are described and a graph comparing performances is given. The advantage of the combined sets with free-piston gas turbines is seen to increase with the specific capacity. E.W.Golding

ELECTRIC MACHINES

621.313.1

2006 LIFE EXPECTANCY OF ELECTRICAL MACHINES WITH VARIABLE LOADS. J.Ben Uri.
Proc. Instn Elect. Engrs, Monogr. 354U, publ. Feb., 1960, 8 pp. To be republished in Part C.

Modern economics demand a reduction in costs and prices, and this usually means reduction in the amount of materials used. The danger is that some of the insulation materials in use have a cellulose base, which means that their ageing may be endangered if the temperature is higher than the 110°C, since, above this temperature, the cellulose materials tend to change quickly their consistency and mechanical strength. It has been generally agreed that the life expectancy of electrical machines should be seven years when continuously under rated load. General equations for change in life expectancy with temperature have been experimentally and partly deductively found and presented by Montsinger and Bussing, and experiments show that the equations are correct for continuous loads. But when the load changes the heating and cooling periods must be taken into consideration. Short-circuits or heavy overloads can be very dangerous. Equations have been developed for load changes and for straightline and exponential temperature changes, and it is shown that the cooling-off period especially can be very dangerous and take a very appreciable part of the life expectancy of the electrical equipment in question. Sample calculations on transformer and intermittent motor loads are included.

621.313.1

2007 CORONA PROTECTION IN THE SLOTS OF ELECTRICAL MACHINES. A.Veverka.
Acta tech. (Prague), Vol. 4, No. 6, 459-73 (1959). In German.

Airgaps are unavoidable between the insulation of armature coils and the iron of high voltage electrical machinery. To avoid corona discharges in these gaps the coil insulation is provided with a semiconducting coating. For better understanding of the behaviour of such coils the surface gradient around a discharge channel in a slot is first determined theoretically from an equivalent circuit. The result of the analysis is an expression for the critical voltage gradient at which corona starts. This result is confirmed experimentally and then applied to the case of h.v. coils on which the coating is nowhere in contact with the iron. The analysis is then extended to the case where the semiconducting coating of the coils touches the iron at points where the coil sides leave the iron. The conclusion is reached that coatings of high specific resistance do not provide protection. E.Erdelyi

621.313.1 : 621.317.333.4

THE LIFE EXPECTANCY OF CLASS A RANDOM-WOUND MOTOR INSULATION AS DETERMINED BY A.I.E.E. STANDARD No. 510 TEST PROCEDURE. See Abstr. 1354

621.313.1 : 621.315.616.95

THE USE OF SYNTHETIC RESINS ON HIGH VOLTAGE WINDINGS OF ELECTRICAL MACHINES. See Abstr. 1339

621.313.12 : 621.315.619

GENERATOR INSULATION SYSTEMS DEVELOPMENT FOR HYPERSONIC AIRCRAFT. See Abstr. 1343

621.313.126

2008 EXCITER RESPONSE TESTS FOR EXCITERS CONTROLLED BY DYNAMIC-TYPE VOLTAGE REGULATORS. V.C.Strode.
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 795-800 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

It is required that tests on individual components of an excitation system should be accepted as proof of the transient performance of the system as a whole. The exciter response test, outlined in A.I.E.E. Test Code 501, is acceptable for exciters employing a rheostatic-type voltage regulator in appropriate conditions. A new test is proposed for exciters employing dynamic-type regulators. A d.c. generator is provided which gives a delayed step-function voltage to simulate the action of the regulator. Definition of excitation system response is discussed and the proposals of the A.I.E.E. Excitation Subcommittee Working Group of the Power Generation Committee are enumerated. A bibliography and a discussion are added. R.G.Jakeman

621.313.222

2009 THE INFLUENCE OF RECTIFIER CURRENT RIPPLE ON D.C. SERIES MOTORS. J.Štěpina and J.Bendl.
Elektrotech. Obzor, Vol. 48, No. 10, 528-35 (1959). In Czech.

The effects of ripple can be especially important when grid-controlled full-wave rectifiers are used. Investigates theoretically the influence of the a.c. component of voltage upon the function of the motor. It is shown that: (a) commutation and core losses are adversely affected; (b) commutation poles do not prevent sparking; (c) commutation conditions are improved by a series choke, by non-laminated commutation poles, or by a resistor in parallel with excitation, the resistance of the latter being 30 to 50 times larger than that of the exciting poles; (d) with respect to core losses it is preferable to use laminated commutation poles and/or, a series choke. The results are illustrated by a calculated example. N.Klein

621.313.29-8

2010 DYNAMIC BEHAVIOUR OF D.C. ROTATING MACHINES FOR ARC WELDING. A.Carrer.
Ricerca sci, Vol. 29, No. 8, 1663-75 (Aug., 1959). In French.

Results of experiments carried out in order to evaluate the suitability of a d.c. welding generator for arc welding in transient conditions are given. Several different types of generator, each having different characteristics, were studied. A coefficient of suitability of a generator for arc welding is proposed, this coefficient being the average of ten determinations made from oscillograms taken during weld-metal deposition on a flat plate using a basic electrode. For English translation, see Brit. Weld. J., Vol. 7, No. 1, 6-14 (Jan., 1960).

621.313.3 : 621.317.37

MEASUREMENT OF THE INTERNAL PHASE ANGLE OF AN ALTERNATOR BY MEANS OF AN ELECTRONIC CHRONOMETER AND ITS APPLICATION TO THE MEASUREMENT OF SYNCHRONOUS REACTANCE. See Abstr. 1364

621.313.322

2011 RECORDING THE OSCILLATIONS OF THE ROTOR OF AN ALTERNATOR UNDER LOAD.
E.Pillet and M.Sabatier.
C.R. Acad. Sci. (Paris), Vol. 250, No. 4, 686-7 (Jan. 25., 1960). In French.

An electronic impulse corresponding to the network voltage peak (V) and a second impulse corresponding to the peak e.m.f. of the alternator (E) are recorded on an oscillograph screen in such a way that the distance between the points is a measure of the phase displacement between E and V. The trace on the screen shows clearly the oscillations which occur when there is an abrupt change of load and this method of recording rotor oscillation can be used in the evaluation of damping devices. D.R.Way

621.313.322

2012 THE PRACTICABILITY OF MICRO-TURBO-GENERATORS FOR DYNAMIC MODELS FOR 3-PHASE SYSTEMS. H.Rachel.
Elektrie, Vol. 13, No. 6, 219-24 (June, 1959). In German.

It is pointed out that dynamic models used up to the present consist of salient-pole machines and that it is impossible to simulate all the desired characteristics, particularly the time-constant of the exciting winding. The possibility of using a turbo-type model is investigated in detail and it is shown that this has marked advantages. A model rated at 6.3 kVA has been built and tested to simulate a generator of 63 MVA, but a description of this is not given. R.G.Jakeman

621.313.322 : 621.317.38

TRANSIENT TORQUE AND LOAD ANGLE OF SYNCHRONOUS MACHINES. See Abstrs. 1365-6.

621.313.322-81

2013 THE DEVELOPMENT OF DIRECT GAS COOLING AS APPLIED TO LARGE TURBO-ALTERNATORS.
K.Hobley.
Engl. Elect. J., Vol. 16, No. 3, 3-16 (Sept., 1959).

A detailed description of direct gas-cooling through the rotor and stator windings, with particular reference to the 100 MW alternator at the Willington "A" power station. The construction is explained and comparison is made with conventional designs. Many illustrations, including diagrams of the gas flow, and sectional drawings are given. An isometric section through a typical direct-cooled alternator is included. Descriptions are given of the H-seal and H-blower. Test results are added. R.G.Jakeman

621.313.323

2014 SHORT-CIRCUIT IMPEDANCE OF THE DAMPER WINDING OF SALIENT-POLE SYNCHRONOUS MOTORS.
R.Tuschák.
Elektrotechnika, Vol. 52, No. 8-9, 337-57 (Aug.-Sept., 1959). In Hungarian.

The direct- and quadrature-axis impedances of salient-pole synchronous motors are analysed during asynchronous starting. Simple equivalent circuits are given on the assumption that the current in the conductor bars has a sinusoidal distribution along the pole face. A practical method is given and examples are worked out. L.Csuros

TRANSFORMERS

621.314.2 : 681.142

2015 IMPULSE STRESSES IN TRANSFORMER WINDINGS. I-II. R.A.Zambardino.
Elect. Times, Vol. 137, 3-8 (Jan. 7); 81-4 (Jan. 21, 1960).

Surveys the problems of impulse stresses, and describes the use of a DEUCE computer for calculating the initial voltage distributions in transformer windings, under surge conditions, from an equivalent circuit. Interleaved windings are particularly considered, and the results obtained are shown to agree with test figures. Computing times of the order of a few hours are unfortunately necessary even for simple cases, but equivalent circuits using lumped parameters may be used in many cases to calculate terminal voltages in only a few minutes. M.R.Dickson

621.314.2

2016 CALCULATION OF OVERVOLTAGES IN TRANSFORMERS IN THE CASE OF A FAULT TO EARTH IN THE NETWORK. E.Werth.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 22, 788-90 (Nov. 11, 1959). In German.

Sets out a method of calculating the maximum voltage induced in the low tension windings of a transformer in the event of a single-phase fault in the high-tension network, given the transformation ratio and the separate capacitances of each part of the circuit. It is then a straightforward matter to calculate the additional capacitance required to ensure full protection of the transformer. Experimental results obtained showed a maximum variation from calculated values of only 5%. D.R.Way

621.314.2

2017 SHORT CIRCUIT [S.C.] STRENGTH TEST FOR LOW POWER TRANSFORMERS. C.Rukszto.
Energetyka (Poland), Vol. 13, No. 4, 106-10 (1959). In Polish.

The project for s.c. test is discussed. Transformers of 50 to 1700 kVA were tested and only four of them passed the test without damage. On the basis of the work, suggested tests on transformers in production and modifications of the projected tests are given. M.W.Makowski

621.314.2

2018 HIGH-VOLTAGE EXPERIMENTS AND THEIR EVALUATION FOR DESIGN OF TRANSFORMERS.
K.Walther.
Elektrie, Vol. 13, No. 9, 333-6 (Sept., 1959). In German.

A brief survey is given of investigations of electrostatic problems in transformers covering: determination of voltage distribution; investigation of stress fields in electrolytic tanks; Rabus method of comparing the breakdown strength of a model with

the actual arrangement of transformer insulation, the basis of comparison being the distribution of lines of force in the critical wedge of insulating medium. Several examples are given to illustrate experimental methods. The actual stresses and breakdown strength of the completed transformer may differ from those obtained by experiment on the model arrangement. To ensure that insulation is not stressed beyond permissible limits, safety factors are introduced, depending on the insulation arrangement, manufacturing processes and previous experience. W.J.Grek

621.314.2 : 621.387

2019 TRANSFORMER DESIGN FOR TOROIDAL DISCHARGE SYSTEMS. R.Carruthers.
Proc. Instn Elect. Engrs, Paper 2895 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, 138-41, 142-7).
Republication, with discussion, of the paper already abstracted as Abstr. 2661 (1959).

621.314.2

2020 THE LOSSES IN THE COVERS OF SINGLE- AND THREE-PHASE TRANSFORMERS. J.Turowski.
Rozprawy elektrotech., Vol. 5, No. 1, 87-119 (1959). In Polish.
The formulae of losses on ferromagnetic and non-ferromagnetic materials are given. By suitable approximation the formulae are applied to single- and three-phase transformers, the losses in the latter being approximately $\sqrt{3}$ times greater than in single-phase transformers. The influence of secondary factors, particularly the saturation in covers, is discussed and accounted for by a correction coefficient. The experimental measurements confirmed the theoretical results. M.W.Makowski

621.314.2 : 681.142

2021 THE INFLUENCE OF PERFORMANCE AND DESIGN LIMITS ON THE DESIGN OF POWER TRANSFORMERS BY COMPUTER. W.G.Chambers.
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 971-6 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).
The design by computer of core-form liquid-immersed transformers from 500 to 15 000 kVA is considered. A complex trial-and-error process is necessary, and this is flow-charted in outline and discussed in detail. The effect of discrete steps in the variables caused by having to use standard parts is taken into account, and the desirability of starting from a good initial selection of parts emphasised. In particular, a series of designs can be made having a range of departures from certain nominal values of, for example, impedance, and these designs used as starting points for the general procedure. Not only does this save time, but better consistency of design is maintained. G.A.Montgomerie

621.314.2 : 621.316.932

CONTRIBUTION TO INSULATION COORDINATION FROM THE POINT OF VIEW OF TRANSFORMER PROTECTION.
See Abstr. 1302

621.314.211.018.756

2022 THE ZETA TRANSFORMER AND AUXILIARY CIRCUIT EQUIPMENT. E.R.Hartill.
Proc. Instn Elect. Engrs, Paper 2876 [Convention on Thermonuclear Processes] publ. April, 1959 (Vol. 106A, Suppl. 2, 66-73, 82-4).
Republication, with discussion, of the paper already abstracted as Abstr. 2666 (1959).

621.314.224

2023 THE SECONDARY CURRENTS IN CURRENT TRANSFORMERS UNDER TRANSIENT SHORT-CIRCUIT CONDITIONS. H.F.Vogel.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 19, 665-71 (Oct. 1, 1959). In German.
Equations are developed for the secondary currents on the assumption that the saturation curve can be simulated by 2 straight lines, one sloping up to the knee and the other horizontal. It is shown that the thermal and mechanical stresses in the secondary circuit depend mainly on the amount and the p.f. of the burden. Also that the use of Mumetal, although largely employed in present-day practice, has little effect in limiting the secondary current. A numerical example is given. R.G.Jakeman

621.314.224.3

2024 TERMINAL LUGS AND CURRENT CONNECTION BARS FOR CURRENT TRANSFORMERS. F.Schubert.
A.E.G. Mitt., Vol. 49, No. 1, 28-32 (Jan., 1959). In German.
Details are given in tabular form of proposed standard sizes and number of connection bars in Cu or Al, and the number, size and spacing of clamping bolts. C.F.Pizzey

POWER CONVERSION

621.314.57 : 621.34

MERCURY ARC CONVERTORS FOR ROLLING-MILL DUTIES.
See Abstr. 2098

621.314.58

2025 A MORE STABLE 3-PHASE TRANSISTOR-CORE POWER INVERTER. W.E.Jewett and P.L.Schmidt.
Trans. Amer. Inst. Elect. Engrs I, Vol. 78, 686-91 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).
Discusses the superior reliability and performance of the 3-phase motor for a missile gyroscope, and the need for a 3-phase invertor power source. The wave-shape characteristics for a 3-phase square-wave system are presented and its limitations indicated. The operation of a basic invertor is briefly outlined with circuit diagrams and graphs. (See Abstr. 4618, 4863 of 1955). The synchronizing circuit described by Milnes is explained, and the need for the power amplifier stage discussed, with a connection diagram. The additional circuitry required to make the invertor almost completely insensitive to a degree of load variation and unbalance is described, and an appendix gives details of the components, including the transformer cores and windings. 5 references.
E.F.Hansford

621.314.58 : 537.3

2026 USE OF A THERMISTOR AS A D.C.–A.C. CONVERTER. N.W.Bell.
Rev. sci. Instrum., Vol. 31, No. 1, 65 (Jan., 1960).
A thermistor was used in a negative feedback amplifier for d.c. to a.c. conversion at a frequency of 30 c/s and with a zero drift of 10 μV per day. A.J.Ingels

621.314.6

2027 SOME CONSIDERATIONS IN THE APPLICATION OF POWER RECTIFIERS AND CONVERTORS.
J.P.McBreen.
Proc. Instn Elect. Engrs, Paper 3215U, publ. Feb., 1960, 10 pp.
To be republished in Vol. 107A (1960).
Reviews the more important considerations in the selection and application of power rectifiers and convertors. It begins with a discussion on the suitability and selection of semiconductor and mercury-arc rectifiers and convertors for various applications, and proceeds to a discussion on the number of phases to employ and how this question is affected by supply and other considerations. The effect of rectifier-fed rolling-mill and winder drives on the supply system is discussed. A summary of the characteristics of the transformer connections in more general use is included, together with some notes on their application. Mention is made of parallel operation, and some examples are given of how phase multiplication is achieved. Then follows a discussion on possible faults and their prevention; protection requirements are outlined and the paper concludes with some notes on installation and ventilation. In the main, only British practice is discussed.

621.314.63

2028 THE THERMAL BEHAVIOUR OF SEMICONDUCTOR RECTIFIERS. O.Jakits.
Brown Boveri Rev., Vol. 45, No. 11-12, 540-4 (Nov.-Dec., 1958).
Describes measurements performed with heavy current germanium diodes, the actual problem being a continuation of work already covered by the literature. An electronic method of determining the thermal inertia of the elements is described, the results being interpreted with the aid of a simple thermal model. The effect of cooling on the resultant overload characteristic is discussed. It may be concluded that cooling cannot protect an element against brief, heavy overcurrents, although it can offer some measure of protection against small overloads of long duration.

621.314.63

2029 SOME PERFORMANCE PARAMETERS OF SILICON JUNCTION POWER RECTIFIERS. D.R.Coleman.
Electronic Engng, Vol. 32, 98-102 (Feb., 1960).
The electrical performance of silicon power rectifiers — seen

in terms of the power output of a conversion connection — is related to their characteristics, and shown to be dependent upon junction temperature. Temperature control is discussed from the thermal resistance standpoint, and a method is given for the calculation of power dissipation and connection ratings for silicon rectifiers. Mention is made of some considerations necessary for satisfactory transient performance.

621.314.63

2030 THE POWER RATING OF SEMICONDUCTOR RECTIFIERS. J.I.Miissen.

Proc. Instn Elect. Engrs, Paper 3068 E [International Convention on Transistors and Associated Semiconductor Devices], Vol. 106B, Suppl. 17, 968-81, 1009-11 (1959).

The widespread use of semiconductor rectifiers, with their extremely high conversion efficiency, ability to operate at high reverse voltages and consequent small size, has brought in its train problems peculiar to these devices. It is important, therefore, that the electrical ratings should be established on both a systematic and rigorous basis with the specific problems in mind. Certain electrical parameters such as forward and reverse voltage and current, thermal resistance and junction temperature, have obvious effects on the electrical rating of the rectifier. Others, such as thermal capacitance and carrier storage time, affect the rating indirectly, but are no less important. Some of the factors which influence the rating of germanium and silicon junction rectifiers are considered, and the procedure for obtaining the curves of rectified current rating as a function of ambient temperature is given. Determination of overload characteristics and the associated use of thermal-electrical analogue techniques are described. Methods for deriving the derating factor for parallel operation, operation at higher mains frequency and at high altitude are also given.

621.314.63 : 621.34

SLIP-POWER RECOVERY AND USE OF SILICON RECTIFIERS. See Abstr. 2099

POWER TRANSMISSION
OVERHEAD LINES . CABLES

621.315.1/.2

2031 OVERHEAD LINES VERSUS UNDERGROUND CABLES. AN ECONOMIC AND OPERATIONAL COMPARISON.

N.G.Simpson and P.W.Cave.

Elect. Rev., Vol. 166, No. 4, 167-71 (Jan. 22, 1960).

The discussion of the economics includes the cost of obtaining wayleaves and other preparatory work as well as capital and running costs. The different operational characteristics of the two systems are also shown to affect costs. A review of developments in design and operation and an indication of future trends is included.

621.315.17

2032 PHOTOGRAMMETRIC AERIAL SURVEY FOR H.V. LINES. D.Stiefel.

Elektrotech. Z. (E.T.Z.) B, Vol. 11, No. 11, 444-51 (Nov. 21, 1959). In German.

Aerial photography has not been used in Germany for overhead-line construction and its possibilities and results obtained in other countries are therefore reviewed. The main advantage is the saving in time in route selection and wayleave negotiations as the practicability of alternative routes and suggested deviations can quickly be established. Tower positions can generally be fixed with sufficient accuracy to enable the bulk of material to be ordered in good time. The detailed ground-level survey can then be made at leisure. The technique of the production of profiles and strip maps is described. It is emphasized that the work must be carried out by specialists. A.P.Wilmshurst

621.315.17

2033 VERY-HIGH-VOLTAGE LINES SUITABLE FOR CONVERSION TO A HIGHER VOLTAGE.

H.Meyer and W.Philipps.

Elektrotech. Z. (E.T.Z.) B, Vol. 11, No. 11, 451-5 (Nov. 21, 1959). In German.

Very-high-voltage lines are generally not convertible unless such provision is made in the design. Methods adopted in various countries are reviewed. Suggestions are made for the design of 110 and 220 kV double-circuit lines which may later be converted to 220 or 380 kV. When considering economics account must be taken of the time during which a line must be out of service for conversion. A.P.Wilmshurst

621.315.17

2034 A NEW DIRECT MATRIX INVERSION METHOD. R.B.Shipley and D.Coleman.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 568-72 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Describes a special-purpose matrix inversion technique developed by the Tennessee Valley Authority for use in economic, short-circuit and equivalent studies. Power transmission system matrices are usually large, contain complex numbers, are symmetrical about the major diagonal, and have non-zero elements along the diagonal which are larger than the off-diagonal elements. The admittance matrix frequently contains zeros in about 90% of the off-diagonal terms. Advantage is taken of these special characteristics to gain computer speed and to reduce the high-speed memory requirements. This is partially accomplished by storing only the diagonal and one half of the non-diagonal elements. Only one half of the non-diagonal elements are calculated and zero recognition is used to improve speed. The method is believed to be faster than other methods available to the industry. A.P.Wilmshurst

621.315.2 : 620.193

ON THE BEHAVIOUR OF "SEMICONDUCTING CORROSION COATINGS" UNDER THE INFLUENCE OF DIRECT CURRENT. See Abstr. 2612

621.315.21

2035 LIMITING TEMPERATURES ON OVERLOADED ELECTRICAL LINES. F.Fabinger.

Elektrotech. Obzor, Vol. 48, No. 10, 514-28 (1959). In Czech.

Considers ageing of electrical insulation and discusses Montsingers exponential relation for the temperature dependence of lifetime, L. Applies the relation to insulated conductors and investigates the influence of temperature variations upon L. Calculates L and temperature limits for cyclically varying loads and temperature limits on overload of short duration. N.Klein

621.315.21

2036 ELECTRIC STRENGTH OF IMPREGNATED-PAPER CABLE INSULATION ON SIMULTANEOUS APPLICATION OF A.C. AND D.C. VOLTAGE. M.Rapoš.

Elektrotech. Obzor, Vol. 48, No. 12, 638-44 (1959). In Slovak.

Discusses breakdown on the application of a.c. and d.c. voltage respectively and points out the differences. Based on experimental observations described in the literature it is concluded that when a ripple is superposed on a d.c. voltage, the breakdown is typical of the d.c. case up to a limiting magnitude of the ripple. Further, when a d.c. component is added to the a.c. voltage, the breakdown is characteristic of the a.c. case up to a limiting magnitude of the d.c. component. These limits are estimated. N.Klein

621.315.22

2037 THE DEVELOPMENT OF ELECTRIC CABLES [FOR USE] IN MINES. M.Osty.

Rev. gen. Elect., Vol. 68, No. 12, 668-72 (Dec., 1959). In French.

Describes new developments in the construction of rigid, flexible, and semi-flexible cables for use in mines. Single- and multiple-screened types are illustrated, together with a short description of an apparatus for carrying out flexing tests on cables and conductors.

621.315.23 : 536.2 : 537.3

2038 TRANSIENT TEMPERATURE RISE DUE TO A LINE SOURCE IN A SEMI-INFINITE MEDIUM, WITH A RADIATION BOUNDARY CONDITION AT THE INTERFACE. H.Goldenberg.

Brit. J. appl. Phys., Vol. 10, No. 7, 314-17 (July, 1959).

An approximate formula and an error bound are given for the deviation between this solution and the solution subject to an isothermal boundary condition at the interface. A condition is given for the validity of Neher's approximate formula [Abstr.2387 of 1949, Elect. Engng, N.Y., Vol. 67, 412 (May, 1949)] for the steady-state temperature. In a typical example it is shown that the temperature rise above ambient at the surface of a buried cable differs negligibly when the two types of boundary condition are assumed valid at the earth's surface.

621.315.28

2039 RELIABILITY OF GLASS SEALS FOR UNDERSEA CABLES. D.R.Oswald.

Bell Lab. Record, Vol. 37, No. 11, 415-18 (Dec., 1959).

The object of the investigation was to determine the effect of "electrolytic" conduction, due to impurities in the glass, over a long period of time. The use of an optical retardation method enables small changes in the composition of the glass to be detected. It was concluded that the expected life of the glass seal exceeded that specified for the cable itself. V.G.Welsby

621.315.28 : 621.317.333.4

FAULT LOCATOR EXPEDITES REPAIRS ON PLUM ISLAND SUBMARINE CABLE. See Abstr. 1353

621.315.285

2040 CALCULATION OF TRANSIENT MOTION OF SUBMERGED CABLES. T.S.Walton and H.Polachek.

Math. Comput., Vol. 14, 27-46 (Jan., 1960).

The system of nonlinear partial differential equations governing the transient motion of a cable immersed in a fluid is solved by finite difference methods. This problem may be considered a generalization of the classical vibrating string problem in the following respects: (a) the motion is two-dimensional; (b) large displacements are permitted; (c) forces due to the weight of the cable, buoyancy, drag and virtual inertia of the medium are included; and (d) the properties of the cable need not be uniform. The numerical solution of this system of equations presents a number of interesting mathematical problems related to: (a) the nonlinear nature of the equations; (b) the determination of a stable numerical procedure; and (c) the determination of an effective computational method. The solution of this problem is of practical significance in the calculation of the transient forces acting on mooring and towing lines which are subjected to arbitrarily prescribed motions, but is also applicable to a wide class of engineering problems involving the motion of cables, such as: (a) the laying of submarine telegraph cables; (b) the towing of a ship or other object in water, or (c) the snapping of power lines as a result of transient forces caused by storms.

INSULATORS
SUPPORTS . CONNECTIONS

(See also Insulating Materials)

621.315.616 : 621.315.21

EXPERIENCE WITH PLASTIC-INSULATED CABLES AND WIRES UP TO 1 kV. See Abstr. 1239

621.315.616.96 : 621.316.57

USE OF EPOXY RESINS IN HIGH VOLTAGE CIRCUIT BREAKING EQUIPMENT. See Abstr. 1271

621.315.616.96 : 621.315.62

EPOXY-RESIN INSULATORS. BEHAVIOUR TOWARDS POLLUTION AND HUMIDITY. See Abstr. 1248

621.315.673.3 : 621.316.17

SOCKET-OUTLETS IN PUBLIC AUTHORITY HOUSING. See Abstr. 1265

621.315.668

2041 TRENDS IN DEVELOPMENT OF OVERHEAD LINE CONSTRUCTION. H.Mors.

Elektrotech. Z. (E.T.Z.) B, Vol. 11, No. 11, 439-44 (Nov. 21, 1959). In German.

Practice in Germany is compared with that in other countries with a view to reducing costs particularly of very-high-voltage lines. Possibilities include reduction of the number of tension towers partly by the use of straight-line towers for small angles, selection of suitable steels, use of thin-wall rolled sections for lattice towers, higher proportion of Al in s.c.a. conductor, adaption of foundations to suit the nature of the ground. A.P.Wilmshurst

621.315.668.1

2042 THE ECONOMICS OF THE MAINTENANCE OF WOOD POLES. H.Mackedanz.

Elektrizitätswirtschaft, Vol. 58, No. 20, 710-14 (Oct. 20, 1959). In German.

Most poles are maintained at regular intervals. A formula is developed, taking account of all the variable factors from which the most economical interval can be determined; this can be taken from a nomogram. It is shown by examples that any maintenance, particularly of poles in l.v. lines, may be uneconomic. Initial impregnation is most important for resisting biological attack as subsequent treatment often does not reach the parts most likely to be affected. A.P.Wilmshurst

DISTRIBUTION . INSTALLATIONS

621.316.11 : 681.142

2043 A DEVICE FOR SOLVING MUTUAL INDUCTION PROBLEMS ON A D.C. NETWORK ANALYZER. T.Karlsen and H.A.Wallhausen.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 754-59 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

The d.c. network analyser has generally been considered inadequate for studies of mutual induction. The paper describes a direct-voltage insertion device used by the Detroit Edison Co. in conjunction with its d.c. analysers to solve such problems. The device operates by the simultaneous application of the positive-sequence voltage and one auxiliary voltage in each branch of the zero-sequence system subjected to mutual induction. It is suitable for problems of moderate complexity preferably involving lines of the same voltage. No attempt has been made to make the device automatic. A.P.Wilmshurst

SWITCHGEAR

621.316.5 : 621.039

2044 SOME SWITCHING PROBLEMS IN THERMONUCLEAR RESEARCH. D.L.Smart.

Proc. Instn Elect. Engrs Paper 2932 [Convention on Thermonuclear Processes] publ. April, 1959, Vol. 106A, Suppl. 2, 107-16, 142-7 (1959).

Republication, with discussion, of the paper already abstracted as Abstr. 2711 (1959).

621.316.54 : 621.039

2045 SWITCHING AND CONTROL. M.A.Bird.

Proc. Instn Elect. Engrs, Paper 2879 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106 A Suppl. No. 2, 62-5, 82-4).

Republication, with discussion of the paper abstracted in Abstr. 2714 (1959).

621.316.57

2046 POWER SYSTEM SWITCHGEAR.
II. M.V. AND H.V. CIRCUIT BREAKERS FOR SYSTEMS UP TO 11/15 kV. J.A.F.Harvey.
III. OPEN-TYPE CIRCUIT BREAKERS (33 kV AND ABOVE). G.K.Simpson.
IV. SWITCHGEAR SELECTION AND APPLICATION. J.H.Porter.
Elect. J., Vol. 162, No. 19, 1320-6 (May 8); No. 25, 1727-32 (June 19); Vol. 163, No. 9, 182-7 (Aug. 28); No. 12, 422-9 (Sept. 18, 1959).

For Pt I see Abstr. 4556 of 1959. Pt II discusses phenomena associated with the basic design requirements of switchgear and considers the factors influencing the choice of circuit-breaker for both industrial and substation use. Pt III compares the relative advantages and disadvantages of bulk oil, small-oil-volume and air-blast types and surveys the methods used for arc interruption in these circuit-breakers. Tests which are used to obtain data associated with the following phenomena which arise in circuit-breaker operation are then described: (i) short-circuit current and recovery voltage; (ii) interrupting small inductive or capacitive currents; (iii) out-of-synchronism conditions when connecting two generating sources; (iv) automatic reclosure; (v) mechanical requirements; (vi) environmental testing. Pt IV considers the selection of switchgear with regard to interruption of charging and magnetizing currents and the acceptable level of switching overvoltages. In addition, inherent restriking voltage crests and (for air blast circuit-breakers)

the rates of rise of restriking voltage must be computed for fault clearance under various conditions. In order to specify appropriate MVA and restriking voltage conditions the ultimate developments of the networks must be clearly foreseen. In addition to the electrical factors already mentioned it is necessary to consider siting of the switchgear and also the requirements of associated equipment such as earthing circuits and busbar arrangements. G.V.Hargreaves

621.316.57

2047 A TESTING CODE FOR OIL CIRCUIT-BREAKERS. J.S.Cliff.

Elect. J., Vol. 164, No. 2, 83-5 (Jan. 8, 1960).

Outlines the valuable work of A.S.T.A. in conducting tests and producing documents bearing on the testing and certification of high power circuit-breakers. For example, amendments Nos. 3 and 4 to B.S. 116: 1952 (Oil circuit-breakers for a.c. systems) are based on a modified version of A.S.T.A. Publication No. 5. The important points in these two amendments are discussed and they have produced a short-circuit testing code based on many years of practical experience and resolving many of the difficulties previously arising in interpreting B.S. 116. A.P.Paton

621.316.57.064.24

2048 HIGH-SPEED MAGNETIC AIR CIRCUIT BREAKER FOR DISTRIBUTION CIRCUITS.

H.P.Sleeper and J.D.Findley.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1075-81 (1959) = Pwr Apparatus Syst., No. 45 (Dec., 1959).

A magnetic-type air breaker with 1½ to 2 cycles interrupting time is described. These interrupting times approach those of line reclosers which have proved extremely satisfactory in preventing burndown of overhead distribution conductors.

REGULATION

621.316.717 : 621.34

2049 APPLICATION OF REACTOR CONTROL TO A.C. MOTORS. H.A.Zollinger.

Westinghouse Engr, Vol. 19, No. 5, 156-60 (Sept., 1959).

Describes systems of static control for large wound-rotor and squirrel-cage motors for the following requirements: (a) frequent reversals; (b) repetitive operations; (c) speed control; (d) torque control: (e) cushion starting; and (f) high reliability. A list of applications is given.

621.316.718 : 621.34

2050 ELECTRICAL CONTROLS FOR A TIRE FABRIC TREATING SYSTEM. C.E.Robinson and N.A.Williams.

New York: American Institute of Electrical Engineers No. T-118 (Nov., 1959). Conference on "Rubber and Plastics" (April 22-24, 1959) p. 24-42.

A detailed description of a plant to process rayon and nylon tyre fabric with a latex solution. It consists of a dipping, drying and heat-treating unit, designed to run in tandem with a 2-calender train. The top design speed is 75 yards/min. A drawing of the complete plant is given and the controls of each section are described in detail. The outstanding piece of apparatus is the Rollevator which ensures that every portion of the fabric is exposed to heat for a constant time during the processing cycle. The Rollevator consists of a number of rolls in 2 sections. The top roll in each section is free to move up and down and the two are coupled to each other by means of chains. The operation is explained and characteristic curves given. A schematic diagram for the electrical controls is included. A lengthy discussion is added. R.G.Jakeman

621.316.718 : 621.34

2051 PLASTICS EXTRUDER DRIVE CHARACTERISTICS. G.D.Campbell.

New York: American Institute of Electrical Engineers, No. T-118 (Nov., 1959). Conference on "Rubber and Plastics" (April 22-24, 1959), 135-51.

After defining some of the reasons that variable speed is required, 3 methods are compared: mechanical drive with cone pulleys; eddy-current clutch; Ward Leonard drive. Each method is described and compared as regards economics and suitability to the requirements. Suggestions are made for the selection and test results are included. The application to wire-coating lines is also discussed. Several illustrations are included and a discussion is added. R.G.Jakeman

621.316.718 : 621.34

2052 CONTROL AND REGULATING TECHNIQUES OF MUTATOR REVERSING DRIVES.

J.Förster and H.F.Steinmüller.

A.E.G. Mitt., Vol. 48, No. 11-12, 629-36 (Nov.-Dec., 1958). In German.

A detailed description of various methods for operating reversible drives by means of single or double mutators either in cross or in antiparallel connection, illutrated by wiring and block diagrams, graphs of voltage, current and torque characteristics and by oscillograms. The reversal is accomplished either by armature or by field change-over. Speed regulation is effected by regulation of the armature circuit or by field weakening or by both. Special protective means are described for preventing excess voltages, currents and rates of current rise. R.Neumann

621.316.718 : 621.34

2053 MUTATOR DRIVES WITH SPECIAL CONTROL AND REGULATION PROBLEMS. G.Schliephake.

A.E.G. Mitt., Vol. 48, No. 11-12, 637-41 (Nov.-Dec., 1958). In German.

Elements and connections used in analogue computers may be applied with advantage in control and regulation problems of mutator drives. The principles are discussed and various applications are described and illustrated. Examples are given for electromechanical and electronic multiplication, division, differentiation and integration and for some special applications in rolling-mill operation and their accessories. R.Neumann

621.316.718 : 621.34 : 621.314.57

2054 MOTOR-GENERATOR-FED REVERSIBLE D.C. DRIVES WITH MUTATOR EXCITATION. E.Golde.

A.E.G. Mitt., Vol. 48, No. 11-12, 642-8 (Nov.-Dec., 1958). In German.

The advantages are explained of exciting the fields of a Ward Leonard set for reversible drives by mutators. The generator field is preferably fed by two cross-connected mutators, the motor field by a single rectifier. Curves show the functional relation between the speed of the reversible motor, its armature and field voltages and currents and time. The various regulating methods are described in detail. The dynamic properties of the drive are materially improved. No contacts, to be operated during service, are required. Quick acting and accurate limitation of current and voltage are achieved. The operator can concentrate his attention on the cycle of work. R.Neumann

621.316.718

2055 PHOTOELECTRIC APPARATUS FOR AUTOMATIC SPEED REGULATION OF MOTOR VEHICLES.

K.P.Beisse.

Elektronik, Vol. 8, No. 9, 271-2 (Sept., 1959). In German.

The apparatus is intended to reduce the number of accidents at moderate and slow speeds in areas of dense traffic by eliminating the human reaction time spent in braking. An optical system fitted on the car consists of a long focus lens, an apertured diaphragm, a rocking slotted disk and a photocell. The distance between the lens and the diaphragm is controlled by the car speed so that the field of view covered lies at a point in front of the car corresponding to the braking distance. Any object appearing in the field of view, the image of which is chopped by the rocking disk, greatly increases the photocell current. This current is amplified in two stages and used to control two relays of different sensitivity. The first to operate controls the throttle and reduces the speed; the second applies the brakes. H.G.M.Spratt

621.316.718

2056 REGULATING CIRCUITS WITH CONVERTORS. R.Jütten.

A. E. G. Mitt., Vol. 48, No. 11-12, 613-21 (Nov.-Dec., 1958). In German.

The stability and accuracy of control systems are investigated. The frequency response of typical network sections is discussed, and the effect of controller amplifiers, compensating devices and feedback is explained. As an example, d.c. motor speed-control by control of armature and field current is examined. P.Szekely

621.316.718

2057 CONTROLLED RECTIFIERS DRIVE A.C. AND D.C. MOTORS. W.R.Seegmiller.
Electronics, Vol. 32, No. 46, 73-5 (Nov. 13, 1959).

Describes the performance of controlled rectifiers, and a method of overcoming the temperature dependence of their gate firing characteristics. A basic half-wave circuit for motor control is given, with component values inserted, and the advantages of using the saturable magnetic-core firing-circuit are outlined. Four application circuit diagrams are given, with component values and a brief description of their performances added. They comprise a half-wave push-pull circuit for reversible driving of a d.c. shunt motor or d.c. torque convertor, and three full-wave push-pull circuits to drive a d.c. shunt motor, an a.c. servo motor and the solenoids in the series actuator of a flight control system. Their significant reduction in size and weight offer unlimited application possibilities for controlled rectifiers, especially for replacing magnetic amplifier output stages in control equipment with load powers greater than 10 watts. 5 references. E.F.Hansford

621.316.718.1

2058 OPERATION OF A REVERSIBLE ROLLING MILL BY A D.C. MOTOR FED BY MERCURY VAPOUR RECTIFIERS. E.Chiesa.
Elettrotecnica, Vol. 46, No. 12, 828-45 (Dec. 10, 1959). In Italian.

The optimal conditions for motors, rectifiers and control gear are investigated to ensure max. production, min. cost and max. safety and continuity of operation. A brief comparison is made of the use of rotary convertors and of rectifiers for feeding a reversible motor. Three fundamental schemes are shown for the use of metal-vapour rectifiers. The scheme adopted provides for a separate rectifier for the armature and field circuit, a rapid acting change-over switch for reversing the armature current, several six-anode grid controlled fan-cooled rectifiers working in parallel and fitted with anode reactors for the correct distribution of the current. These rectifiers are connected to a six-phase transformer and supply the armature current. The field current is supplied by a three-phase grid controlled rectifier. The advantages of the scheme are discussed. The control circuits for the armature, the field and the change-over switch comprise 5, 3 and 4 magnetic amplifiers respectively. Details of these control circuits are shown. Provision is made for limiting the acceleration, the current and voltage of the armature and the rate of change of armature current. Oscillograms show the results obtained. R.Neumann

621.316.72

2059 MAINS DERIVED A.C. AND D.C. CONSTANT VOLTAGE AND CONSTANT CURRENT SOURCES. R.Stenzel.
Arch. tech. Mseesn. No. 284, (Ref. Z40-2), 193-6 (Sept.); No. 286, (Z40-4), 237-40 (Nov., 1959). In German.

Reviews first of all self-stabilizing components such as barretters, gas-discharge tubes, semiconductors, saturable inductors and transformers and carbon-pile regulators. Comparatively simple circuits embodying some of these elements are shown. Circuits incorporating self-regulating networks are then described. These include circuits embodying gas-discharge tubes as reference sources, various transductor circuits and circuits with light-sensitive elements and servomechanisms. H.G.M.Spratt

621.316.721 : 537.3

2060 THE THEORY OF BALLAST TUBES OR BARRETTERS. R.O.Jenkins.
Brit. J. appl. Phys., Vol. 9, No. 10, 391-4 (Oct., 1958).

The theory is based on a simple graphical method of solving the equation of thermal equilibrium of an electrically heated wire in a gas-filled enclosure. The results account for the main operating characteristics and have accurately predicted the ratings of various low voltage barretters. It is also shown why, in practice, barretters have always consisted of an iron wire in hydrogen.

621.316.722 : 681.142

2061 DISTRIBUTION SYSTEM PRIMARY-FEEDER VOLTAGE CONTROL. IV. A SUPPLEMENTARY COMPUTER PROGRAM FOR MAIN-CIRCUIT ANALYSIS. D.N.Reps and R.F.Cook. Trans Amer. Inst. Elect. Engrs III, Vol. 78, 904-13 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

Previous work (see Abstr. 1412-14 of 1959) used an I.B.M. 704 to analyse distribution system primary-feeder circuit design and voltage control requirements. This paper is designed to deal with only a single 3-phase line; principally through the elimination of programming routines required to study laterals, computer time is reduced from an average of 30 secs to 5 secs. The two principal categories of problems for which it is suitable are: (1) voltage performance calculation and voltage control solution for circuits having only lumped loads; and (2) very rapid evaluation of alternative locations for capacitor banks on the main portion of feeders already studied with the general programme. The new programme flow diagram is given and explained by examples. G.A.Montgomerie

621.316.722.1

2062 ECONOMY IN THE SERIES STABILIZER. D.J.Collins and J.R.Pearce.
Electronic Engng, Vol. 32, 96-7 (Feb., 1960).

It is pointed out that in order to deal with adverse conditions the series stabilizer is uneconomic in its demands on the series elements. If the load current is essentially constant the series element can be shunted by a resistor. The basic circuit is presented of a practical solution to the problem of a variable load current using a resistance-shunted buffer section.

621.316.722.1

2063 A VOLTAGE REGULATOR FOR LARGE POWER SYSTEMS. V.Easton and K.C.Parton.
G.E.C.J., Vol. 26, No. 3, 91-100 (Summer, 1959).

Describes the operation of and gives test results for a static magnetic-amplifier voltage regulator of the continuously acting type capable of controlling the largest alternator. An automatic overriding control is included which is responsive directly to the rotor load angle, which under any loading condition will prevent the excitation being adjusted to such a value that the preset maximum rotor angle can be exceeded. G.V.Hargreaves

621.316.722.1

2064 A TRANSDUCTOR REGULATOR FOR STABILIZED POWER SUPPLIES. A.N.Heightman.
J. Brit. Instn Radio Engrs, Vol. 20, No. 2, 105-23 (Feb., 1960).

A new form of transductor regulator is described which is principally intended for use in voltage-stabilized power supplies delivering output currents of ~1 A. Better efficiency and reliability is obtained than is usually possible with the conventional series-valve regulator, and the complete power supply can also be physically smaller. The transductor circuit is unusual in that full-wave operation is obtained with a transductor having only one core and, in the simplest case, only one winding. A definite limit exists, however, to the range of regulation that can be obtained. The relatively slow response of the transductor generally necessitates the incorporation of a valve regulator to deal with rapid disturbances; such a regulator, working under Class B conditions for high efficiency, is also described. Details of a complete power supply embodying both regulators are given, and a simpler power supply using only the transductor regulator is briefly discussed.

621.316.722.1 : 537.3

2065 TIME-CONTROLLED UNIT-FUNCTION, CONSTANT-VOLTAGE GENERATOR. Y.Ettinger and H.Edels.
J. sci. Instrum., Vol. 36, No. 8, 362-4 (Aug., 1959).

The generator has a variable output amplitude from 40 to 1000 V with a rise time of 1 μs and constant for 150 μs. The output voltage is independent of current from 0 to 12 A and can be applied with an accuracy of ±1 μs. The generator consists of a source of high-capacity capacitors connected in parallel with non-inductive capacitors which supply the initial energy at a high rate. A mercury thyratron (type BT61A) with a special triggering circuit gives the necessary time control. By keeping the thyratron at a constant temperature, its appropriate volt–ampere characteristic shows that the voltage amplitude is maintained constant independent of variation in current output. A high rate of rise of the unit function is achieved by connecting a high-voltage auxiliary circuit between anode and cathode. Detailed circuit diagrams of the generator, etc., are given. The effects of temperature, accentuation of field due to additional space charge and oscillations on the voltage waveform are also discussed.

621.316.722.1

2066 A FERRORESONANT VOLTAGE STABILIZER WITH COMPENSATING CAPACITOR. V.I.Kislov.
Radiotekhnika, Vol. 14, No. 12, 71-6 (Dec., 1959). In Russian.

The stabilizer described, with a stabilizing coefficient of about 10, is suitable for small local apparatus, and departs from usual

practise in using two capacitors, one of which replaces the compensating winding on an unsaturated transformer. Advantages claimed are reduced size, higher efficiency and less noise.

F.Quelon

621.316.726 : 621.373.4 : 537.7

2067 AUTOMATIC Q-METER PEAKING CIRCUIT. F.M.Wanlass.

Rev. sci. Instrum., Vol. 31, No. 2, 199-201 (Feb., 1960).

The circuit, when used with an ordinary Q meter, will measure the Q and the capacitance of a low loss sample in parallel across the Q-meter tank circuit rapidly and continuously without the necessity of constant hand tuning of the tank circuit to resonance. Employing this circuit, it is possible to observe Q and capacitance changes that have a time constant of 0.3 sec or greater.

621.316.727

2068 ANALYSIS OF CAPACITOR APPLICATION AS AFFECTED BY LOAD CYCLE. R.F.Cook.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 950-57 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

The use of approximate formulae for determining the size of shunt capacitors in distribution networks may well lead to an increase in energy losses instead of the decrease desired. A rigorous analysis is presented from which a generalized family of curves is produced which enables the capacitor rating to be determined for a given reduction in energy loss and a given reactive load factor.

M.Rathbone

621.316.728 : 621.314.63

2069 THE SILICON CONTROLLED RECTIFIER DIMMER. H.R.More and A.W.Malang.

J. Soc. Motion Picture Televis. Engrs, Vol. 68, No. 10, 678-83 (Oct., 1959).

Describes 4 kW and 10 kW dimmers, explaining the advantages of using two silicon controlled rectifiers connected back-to-back, in preference to one rectifier controlling the current in a saturable reactor. Besides offering reduced weight, bulk, heat dissipation and noise when compared with three other types, they give immediate response, infinite loading, an excellent dimming curve and higher efficiency. Some of the many possible lighting combinations are outlined, and the use of these dimmers in a television studio installation is described in detail.

E.F.Hansford

621.316.728 : 621.385.623.5

2070 A POWER STABILIZER FOR FREQUENCY MODULATED MICROWAVE OSCILLATORS.

H.A.Dijkerman, C.Huiszoon and A.Dymanus.

Appl. sci. Res. B, Vol. 8, No. 1, 1-7 (1959).

Describes a microwave power stabilizer with short time-constant, by means of which a f.m. microwave signal of constant amplitude is obtained. Possible applications in measurements on microwave components and in the field of microwave spectroscopy are mentioned.

621.316.73 : 621.318.3

2071 STABILIZATION OF THE MAGNETIC FIELD OF AN ELECTROMAGNET. R.Becherer and R.Reimann.

C.R. Acad. Sci. (Paris), Vol. 249, No. 15, 1340-2 (Oct. 12, 1959). In French.

An arrangement for reducing the slow and rapid fluctuations of an electromagnet field is described. Rapid fluctuations are reduced by a transistor regulating system and slow fluctuations and removed by making use of the magnetic resonance of protons in an arrangement using a Clapp oscillator stabilized by a quartz crystal. Stability higher than 5×10^{-9} is obtained.

R.C.Glass

621.316.74

2072 CONTACT WELDING IN THERMOSTATS. R.J.Bishop and P.Howarth.

G.E.C.J., Vol. 26, No. 3, 114-19 (Summer, 1959).

In many domestic heating appliances excessive heating is prevented by a thermostat consisting of a pair of contacts which separate when a certain temperature is reached, and thus break the circuit. After many such operations the contacts tend to weld together and their separation becomes uncertain. An experimental study of the strength and the frequency of formation of such welds is described.

P.M.Davidson

621.316.74 : 536.58

2073 TEMPERATURE CONTROLLER BASED ON MEASUREMENT OF RATE-OF-CHANGE OF TEMPERATURE.

A.B.Cairnie and J.D.Pullar.

J. sci. Instrum., Vol. 36, No. 6, 249-52 (June, 1959).

The rate-of-change of temperature of water circulated from a 120 gal tank round the jackets of a direct calorimeter was required never to exceed 0.0005°C/min. Measurement of the rate-of-change of temperature was provided by a gradient layer surrounding a metal block in the tank. A controller was designed to maintain the instantaneous rate-of-change of temperature below 0.0002°C/min, except for a negligible fraction of the time. The mean rate-of-change of temperature is so low that temperature stability to within ± 0.1°C has been obtained for a fortnight. A temperature-controlled room and constant voltage transformer are not required.

621.316.79

2074 AN AUTOMATIC PRESSURE REGULATOR FOR EXTRACORPOREAL CIRCULATION. O.Z.Roy.

I.R.E. Trans Med. Electronics, Vol. ME-6, No. 3, 184-6 (Sept., 1959).

An automatic pressure regulator for controlling venous pressure during extracorporeal heart operations is described. The controller is used in procedures where a pressure is maintained in the venae cavae, i.e., where gravity flow is not used to drain the venous blood. A differential pressure transducer produces an error signal which controls the field current in a d.c. shunt motor and, consequently, the rate of pumping. The sensitivity of the controller can be varied in eight steps; on the most sensitive range, an error of less than 0.20 mm Hg can be detected and corrected. The total change in motor speed and hence pumping rate is ±20%.

PROTECTION

621.316.923

2075 FUSES. L.Hiim.

Elektrotek. T., Vol. 73, No. 1, 1-10 (Jan. 5, 1960). In Norwegian.

The most important properties of l.v. high-power fuses are stated to be the ability to break currents up to the maximum short-circuit current, the ability to protect lines, cables, equipment and machines, selectivity and consumption of fuse itself (watt losses). Semi-enclosed fuses and their limits of application are considered and the operating principles and protection afforded by high-breaking-capacity cartridge fuses and circuit-breakers are compared. Typical oscillograms are given for short-circuit currents and for moderate overcurrents on both a.c. and d.c.

G.N.J.Beck

621.316.923

2076 HIGH-CAPACITY CURRENT-LIMITING FUSES TODAY. E.M.Fitzgerald and V.N.Stewart.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 937-47 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

A current-limiting fuse is defined as one which has the ability to modify significantly the instantaneous current under short-circuit conditions. Some of the considerations presented in this paper are: (1) current-limiting ability is a relative term and must be defined by specific performance characteristics; (2) the degree to which available short-circuit currents can be significantly limited is determined by measurement of maximum peak let-through current at interrupting rating and maximum clearing I^2t over the current-limiting range; (3) many combinations of performance characteristics are necessary to achieve coordinated protection in the numerous current-limiting fuse applications; (4) recognition should be given to wide variations in the melting time—current characteristics in the current-limiting range. Details and characteristic curves are given of a current-limiting fuse developed with an interrupting rating of 2×10^5 r.m.s. symmetrical current at rated voltage and frequency. The new fuse is composed of a multiplicity of silver current-responsive elements and quartz sand. Use of current limiting fuse characteristics for major applications is given.

H.A.Miller

621.316.925

2077 DIFFERENTIAL PROTECTION — SOME NOTES ON THEORY AND PRACTICE. C.Onyemelukwe.

Elect. Times, Vol. 136, 773-6 (Dec. 24); 825-7 (Dec. 31, 1959).

Differential systems are considered with particular reference

to protective schemes for power transformers. Pt I deals with sources of error arising from current-transformer characteristics. Methods of avoiding trouble from such errors are discussed and the special case of switching current surges is dealt with. Pt II discusses time-delay, high-speed biased and magnetic balance schemes in detail, making particular reference to their limitations.

G.V.Hargreaves

621.316.925

2078 TRANSIENT PROCESSES IN FILTERS FOR INVERSE-SEQUENCE SYMMETRICAL COMPONENTS.

M.P.Zlatev, A.S.Kozarov and S.L.Farkhi.
Elektrichestvo, 1959, No. 10, 33-7 (Oct.). In Russian.

The study has arisen from the need to guarantee the performance of a protective relay under conditions both of line asymmetry and of a 3 ph. short circuit over a definite protective length. Criteria are established for choosing the parameters of the filter and, if necessary, of a correction circuit for widening the protected zone. In the analysis two important parameters emerge, one to express the relation between the mechanical parameters of the relay and the length of the protected zone, while the other depends only on the electrical constants of the system and determines the electrical components of the transient process. An example is given of the design of a correcting circuit and its effect illustrated by an oscillogram.

S.C.Dunn

621.316.925

2079 SYMMETRICAL COMPONENT NETWORK CONNECTIONS FOR THE SOLUTION OF PHASE-INTERCHANGE FAULTS. W.H.Ferguson.
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 948-50 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

Severe system disturbances are caused by the loss of proper phase identification and the subsequent incorrect connection where two phases become interchanged. A solution obtained for this type of fault by the method of symmetrical components leads the power system engineer to a better understanding of the effect of the fault and of the action of relays and other protective devices.

G.V.Hargreaves

621.316.925

2080 TRANSISTER-MAGNETIC CONTROL CIRCUITS FOR AIRCRAFT ELECTRIC SYSTEMS. A.W.Pratt.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 643-50 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

The circuits described are for the protection of multiphase systems in aircraft with the object of obtaining optimum utilization of available components, improved performance, operation in severe environmental conditions and greater reliability. Combinations of semi-conductor diodes and transistors with square-loop ferrites (to the exclusion of capacitors) are used in overvoltage, undervoltage and unbalanced-phase protection circuits which include, if required, inverse or fixed time-delays. The overvoltage and undervoltage circuits are unusual in that they operate on the average values of highest and lowest phase voltage of the 3-phase system; the circuits produce pulses which are proportional to the time-integral of the positive half-cycles of the highest and lowest phase voltages and inversely proportional to system frequency. The operation of the pulse-forming circuit and the overvoltage circuit with inverse time-delay are analysed in two appendices.

J.T.Hayden

621.316.925.43

2081 OVERLOAD RELAYS FOR THE PROTECTION OF ELECTRICAL MACHINES. E.Lontay.
Elektrotechnika, Vol. 52, No. 8-9, 369-82 (Aug.-Sept., 1959). In Hungarian.

The basic problems of overload protection are discussed with particular reference to the characteristics of relays with and without the feature of thermal image. A treatment is given of the required characteristics of thermal images. A relay with a thermal image feature is described and practical applications discussed.

L.Csuros

621.316.933 : 537.533

2082 SURGE DIVERTERS USING TRIGATRONS. T.E.Broadbent and A.Fernandez.
J. sci. Instrum., Vol. 36, No. 11, 452-7 (Nov., 1959).

The work described shows that a single-stage trigatron surge diverter is a simple and effective method of removing the voltage from a specimen once the breakdown initiation process occurs. With solid specimens, the device is of value in enabling breakdown tracks to be observed, whilst with gaseous specimens the diverter can conveniently be used in the study of filamentary discharges which occur during the breakdown initiation process. The results of detailed experiments designed to investigate the performance of trigatron surge diverters at direct voltages up to 1000 kV are discussed.

621.316.933.1

2083 THE CHARACTERISTICS OF THE TRIGATRON SPARK-GAP AT VERY HIGH VOLTAGES. T.E.Broadbent.
Proc. Instn Elect. Engrs, Monogr. 364M, publ. March, 1960, 3 pp. To be republished in Part C.

Curves are given showing the working range and time-lag characteristics of a trigatron spark-gap working in air at voltages up to 1 MV. It is shown that, for voltages of this magnitude, a single-stage trigatron spark-gap of suitable design provides a simple and convenient method of chopping the voltage at any required instant. Factors which affect the performance of the gap are discussed.

621.316.935

2084 CALCULATION OF REFLECTION COEFFICIENTS IN THE CASE OF PROTECTIVE RESISTANCES CONNECTED IN PARALLEL WITH SERIES REACTORS. T.Tajthy.
Elektrotechnika, Vol. 52, No. 8-9, 386-8 (Aug.-Sept., 1959). In Hungarian.

A treatment is given of wave reflection related to the practical problem when a series reactor is protected against overvoltages by a parallel linear or non-linear resistor. The author discusses certain statements in the technical literature on the subject and classifies them as erroneous.

L.Csuros

621.316.99 : 621.315.668.2

2085 DEEP EARTHING. J.Ufermann.
Elektrizitätswirtschaft, Vol. 58, No. 8, 245-8 (April 20, 1959). In German.

In order to reduce the footing resistance of individual towers the provision of rod electrodes of up to 75 feet length is suggested if these are capable of reaching a region of high soil-conductivity. Series of curves are reproduced showing the variation of single and multiple rods as a function of depth of penetration and soil resistivity. The economics of the problem are examined with reference to practical examples.

R.H.Golde

621.316.99 : 621.311.4

2086 CORRELATION OF MEASURED AND CALCULATED SUBSTATION GROUND GRID RESISTANCE. A.L.Kinyon.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 698-701 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Discusses results achieved to date by a committee set up to establish a scientific basis for the design of earthing grids for power stations. Existing formulae assume that soil resistance is uniform for a given site, but experiments carried out over a period of years show that calculated resistance varies considerably from measured values. The latter show wide variation according to the moisture content of the soil, the type of instrument (e.g. null-type or moving-coil ohmmeter) used, and the length of time the soil has been allowed to settle since the construction of the station. It is concluded that further detailed research is needed, but that meanwhile time taken in making a detailed survey of the site is well repaid.

D.R.Way

TRACTION . DRIVES

621.331

2087 THE POSITION OF ELECTRIC TRACTION IN FRANCE AND ITS FUTURE DEVELOPMENT. ITS REPERCUSSION IN THE WORLD. F.Nouvion.
Bull. Soc. Franc. Elect., Vol. 9, 621-43 (Oct., 1959). In French.

A review of lines already electrified and scheduled for electrification. The share of the railways of the total French consumption of electric energy is given. Comparisons between 1 ph. and d.c. locomotives (performance and maintenance costs) are made. Other

subjects covered are: (1) better adhesion and its influence upon locomotive design; (2) modern design of the mechanical parts, transformers, rectifiers, traction motors; (3) measurement of the armature temperature; (4) polycurrent locomotives for working on sections where two traction systems meet; (5) effect of the French 1 ph. electrification achievements upon electrification in other countries. A.Karlsbad

621.331

2088 ELECTRIC RAILWAY OPERATION ON THE NORWEGIAN STATE RAILWAYS. E.L.Norgren.
Elektrotek. T., Vol. 73, No. 3, 41-5 (Jan. 25, 1960). In Norwegian.

A review of the present situation. 1580 km of the 4300 km of Norwegian railways are now electrified: however on 1.7.59, 60% of the wagon-axle-km for goods traffic was electric, 23% Diesel and 17% steam. The various forms of electrical supply to the system are discussed. Curves are shown for the tractive effort as a function of speed for the largest Norwegian electric locomotive in service, the 72 ton 2400 kW EL 13, comparing it with the corresponding Diesel locomotive. G.N.J.Beck

621.331

2089 SOME CONSIDERATIONS ON THE DIFFERENT SYSTEMS OF RAILWAY ELECTRIFICATION WITH PARTICULAR REFERENCE TO SOUTH AFRICAN CONDITIONS. A.J.G.Gosling.
Trans S.African Inst. Elect. Engrs, Vol. 50, Pt 5, 98-123 (May, 1959)

Brief details are given of the different systems of railway electrification and the extent to which they are in use throughout the world. The main features relating to the different types of locomotives, overhead track equipment, and substations, are briefly described and compared. The problems associated with the different systems of electrification and the measures which have to be taken to reduce their undesirable effects are considered. The economic aspects as affected by conditions in South Africa are examined and possible future developments are discussed.

621.332

2090 MEASURES IN CONNECTION WITH INTERFERENCE WITH TELECOMMUNICATION INSTALLATIONS BY A.C. RAILWAYS. COMMENTS ON THE NEW DIRECTIVES OF THE V.D.E. R.Buckel.
Elekt. Bahnen, Vol. 30, No. 9, 211-13 (Sept., 1959). In German.

These rules, in force since January 1st 1959, apply to all forms of telecommunication on wires affected by a.c. railways and/or special railway transmission lines. They contain definitions, limits for voltages and currents induced in telecommunication lines, measures, on both sides, to avoid disturbances and risk of danger and detailed information on the calculation of inductive interference, including examples. Alterations and improvements in relation to the previous rules are emphasized. H.R.J.Klewe

621.335 : 681.142

THE TRAIN PERFORMANCE PLOTTER [DER FAHRDIAGRAPH]. See Abstr. 1953

621.335.2

2091 PRIMARY CURRENTS OF MUTATOR-LOCOMOTIVES. R.Jötten.
Elekt. Bahnen, Vol. 30, No. 8, 169-73 (Aug., 1959). In German.

The effects of non-sinusoidal primary currents of mutator-locomotives were investigated neglecting the capacitances of the supply system. The investigations were partly based on experience gained in the operation of the 50 c/s locomotives of the Höllental railway, installed in 1936, and partly on model tests. In dealing with resonance and transient phenomena use is made of the usual circuit theory. The results of the investigation led to the recommendation of damping the higher harmonics by applying an RC element arranged parallel to the primary side of the locomotive transformer or to part of the contact line preferably in a substation. See following abstract. R.Neumann

621.335.2

2092 DAMPING OF HIGHER HARMONICS IN A 50 c/s CONTACT LINE BY THE AID OF AN RC-ELEMENT. R.Buckel, W.Muttelsee and H.Riedel.
Elekt. Bahnen, Vol. 30, No. 8, 173-8 (Aug., 1959). In German.

A detailed report on the tests made on the effects of the application of an RC-element in the Titisee substation of the Höllental railway as recommended by Jötten (see preceding abstr.). The tests showed that under most unfavourable conditions the crest values of the noise currents in neighbouring telephone lines were reduced by 50.8% on an average. R.Neumann

621.335.42

2093 TRANSFORMATION OF FOUR TWIN D.C. MOTOR-COACHES, CLASS ET/ES 182 INTO FOUR TWIN SINGLE-PHASE MOTOR-COACHES, CLASS ET/ES 26. F.Leis and R.Winden.
Elekt. Bahnen, Vol. 30, No. 7, 158-67 (July, 1959). In German.

Originally built for the Berlin City railway, owing to the exigencies of war these coaches were adapted for running on the Isar Valley d.c. railway; as the latter was recently converted into single-phase, both the mechanical and electrical parts of the coaches had to be modified. A new bogie, containing two driving motors, was mounted in place of the much smaller original one with consequent modification to the body. The new electrical equipment includes two standard motors connected in series, a standard transformer and a newly designed rotary tap-changer, driven by an air motor. The main data of the unit are: axle order - B02' + 2'2'; maximum speed - 120 km/hr; max. tractive effort - 3100 kg; 1 hr rating - 580 kW. A.Karlsbad

621.34

2094 WINDING PROCEDURE WITH CONTROLLED TENSION PARTICULARLY AS APPLIED IN PROCESSING HEAT-SET AND CALENDERED FABRIC MATERIAL IN THE RUBBER INDUSTRY. A.V.Alexeff.
New York: American Institute of Electrical Engineers No. T-118 (Nov., 1959) Conference on "Rubber and Plastics" (April 22-24, 1959) 54-70.

621.34 : 621.316.71

2095 D.C. DRIVES FOR WINDERS. L.Abram.
Trans S.African Inst. Elect. Engrs, Vol. 50, Pt 3, 52-80 (March, 1959).

Operational requirements for modern electric winders have resulted in the development of closed-loop control systems. Two such systems, one for a Ward Leonard drive and the other for a rectifier drive, are described and arrangements for obtaining automatic retardation of the winder as the conveyances approach the terminal points of the shaft are discussed. Operational results obtained on winders employing these systems are given and attention is given to the means for stopping the winder in emergencies. It is concluded that the results obtained with the closed loop Ward Leonard system are sufficiently accurate to meet present requirements but that some improvement is still desirable on the rectifier winder. Future developments would, therefore, appear to be aimed mainly at the application of new techniques to achieve similar results.

621.34

2096 CONVERTOR CONNECTIONS FOR REVERSING DRIVES. F.Hölters.
A.E.G. Mitt., Vol. 48, No. 11-12, 621-9 (Nov.-Dec., 1958). In German.

Reviews the armature and field reversing connections, the cross-connected and antiparallel configurations. Investigates their steady-state and transient behaviour and discusses their appreciation. P.Szekely

621.34

2097 POWER FACTOR PROBLEM OF CONVERTOR OPERATED REVERSING DRIVES. F.Hölters and F.Mikulaschek.
A.E.G. Mitt., Vol. 48, No. 11-12, 648-59 (Nov.-Dec., 1958). In German.

During the running up and reversing periods reactive-load impulses arise causing voltage fluctuation on the line. The magnitude of these loads is discussed; various remedial measures are reviewed. Special connections, auxiliary rectifiers and unsymmetrical grid control reduce the reactive current. Performance and cost of these connections are compared with normal arrangements. P.Szekely

621.34 : 621.314.57

2098 MERCURY ARC CONVERTERS FOR ROLLING MILL DUTIES. K.D.Phillips.
Engl. Elect. J., Vol. 16, No. 4, 27-40 (Dec., 1959).

Describes the characteristics of a mercury arc converter with performance curves, and enumerates their advantages and limitations when used for rolling mill drives. The available circuits and control facilities are listed and their application discussed; two methods of protection against backfire are given. A number of existing installations are described, with photographs, where steel-tank mercury-arc rectifiers have been successfully used to drive various types of hot and cold mills. E.F.Hansford

621.34 : 621.314.63

2099 SLIP POWER RECOVERY.
P.Scott.
Elect. Times, Vol. 136, 805-7 (Dec. 31, 1959).

Describes two ways in which silicon rectifiers can save considerable power in variable-speed slipring motor drives, especially for lengthy runs below full speed. The sliprings of the main a.c. driving motor are connected to the input terminals of a three-phase bridge-connected silicon rectifier, which feeds a standard shunt or compound-wound d.c. motor. In scheme A, the d.c. motor is coupled in tandem with the main a.c. motor, adding its power to the main drive. In scheme B, the d.c. motor is coupled to an induction generator which feeds electrical power back to the main supply. The circuit conditions requiring the extra equipment of scheme B are mentioned, and the economic choice of speed range is considered. Performance curves illustrate the power saved on a typical design. The associated switchgear and rectifier protection are outlined, and the operation of starting and speed control described.

E.F.Hansford

621.34 : 621.315.616

2100 DOUBLY INSULATED ELECTRIC HAND-DRILLS.
Electrotechniek, Vol. 37, No. 26, 609-12 (Dec. 24, 1959). In Dutch.

Two forms of double insulation are specified: (1) provision of an insulating sheath around the motor and other live parts inside the metal case of the motor, and insulating the rotor shaft with respect to the driven gearwheel by means of another gearwheel of insulating material; (2) use of a plastic, e.g. polyester resin for the case and handle and insulation of the rotor shaft as in (1). The first form is more suitable for larger types, the second for smaller types of electric drill. The construction of an 8 mm machine of Dutch manufacture is shown in "exploded view". Dutch and C.E.E. regulations for portable motor-driven tools are examined and compared. G.N.J.Beck

621.34 : 621.316.718

2101 A NEW FORM OF CRANE-HOIST CONTROL USING A 3:1 POLE-CHANGING INDUCTION MOTOR.
O.I.Butler and V.Ahmad.
Proc. Instn Elect. Engrs, Paper 3226U, publ. March, 1960, 7 pp. To be republished in Vol. 108A, (1960).

The basic practical requirements of crane-hoist drives are summarized and the latest developments, including closed-loop control methods, in satisfying such requirements with a.c. drives are discussed. In particular, the paper investigates the suitability of an economical design of a 3:1 pole-changing induction motor for crane-hoist drives. In conjunction with a single-phase auto-transformer, the pole-changing motor enables the best use to be made of d.c. and a.c. dynamic braking, which further assists in reducing the energy dissipation in the motor circuits as well as reducing the number and size of the secondary-circuit resistors and contactors. It is shown that the performance characteristics are such as to satisfy crane-hoist requirements without undue complexity of the complete equipment.

621.34 : 621.316.717

APPLICATION OF REACTOR CONTROL TO A.C. MOTORS. See Abstr. 2049

621.34 : 621.316.718

CONTROL AND REGULATING TECHNIQUES OF MUTATOR REVERSING DRIVES. See Abstr. 2052

621.34 : 621.316.718 : 621.314.57

MOTOR-GENERATOR-FED REVERSIBLE D.C. DRIVES WITH MUTATOR EXCITATION. See Abstr. 2054

621.34 : 621.316.718

MUTATOR DRIVES WITH SPECIAL CONTROL AND REGULATION PROBLEMS. See Abstr. 2053

621.34 : 621.316.718

ELECTRICAL CONTROLS FOR A TIRE FABRIC TREATING SYSTEM. See Abstr. 2050

621.34 : 621.316.718

PLASTICS EXTRUDER DRIVE CHARACTERISTICS. See Abstr. 2051

CONDUCTORS . RESISTORS

(See also Semiconductor Materials)

621.315.5

2102 E.H.V. SINGLE AND TWIN BUNDLE CONDUCTORS — INFLUENCE OF CONDUCTOR DIAMETER AND STRAND DIAMETER ON RADIO INFLUENCE VOLTAGE AND CORONA INITIATION VOLTAGE. L.N.Stone.
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1434-43 (1959) = Pwr Apparatus Syst., No. 45 (Dec., 1959).

621.315.53

2103 EXTRA-HIGH-VOLTAGE SINGLE AND TWIN BUNDLE CONDUCTORS. E.Hazan.
Trans Amer. Inst. Elect. Engrs III, Vol. 78, 1425-34 (1959) = Pwr Apparatus Syst., No. 45 (Dec., 1959).

Contains data on eight important aluminium conductors which are being used, or being considered for use, on h.v. and e.h.v. lines. The first part deals with resistance, temperature, and current characteristics. Useful equations and curves are presented describing these characteristics for a broad range of environmental conditions. The second part contains data relating to the economics of conductor selection in single and twin bundle configurations.

INSULATING MATERIALS
DIELECTRICS

621.315.611 : 537.2

2104 MEASUREMENT AND INFLUENCE OF SURFACE CHARGES IN HIGH-VOLTAGE PHENOMENA.
S.I.Reynolds.
Elect. Engng, Vol. 78, No. 11, 1090-4 (Nov., 1959).

A discussion of the formation of positive and negative charges left on the surface of insulation as a result of the electric discharge between a metal and a dielectric surface. Results of measurements with the rotating probe electrometer are given.

621.315.612 : 539.2 : 537.2

2105 SILICON NITRIDE THIN FILM DIELECTRIC.
C.R.Barnes and C.R.Geesner.
J. Electrochem. Soc., Vol. 107, No. 2, 98-100 (Feb., 1960).

Thin adherent nonporous films of pure silicon nitride were deposited from the vapour phase on hot molybdenum substrates by pyrolytic deposition. Such films, when incorporated between molybdenum plates to form capacitors, were found to maintain satisfactory dielectric properties up to and above 600°C. Silicon nitride coatings, deposited by the method described, also offer a convenient and effective method of encapsulation for protecting metal surfaces from atmospheric oxidation up to and above 1000°C.

621.315.612.4 : 539.2 : 537.2

2106 DETAILED STUDY OF SWITCHING CURRENT IN BARIUM TITANATE. M.E.Drougard.
J. appl. Phys., Vol. 31, No. 2, 352-5 (Feb., 1960).

The polarization reversal process in ferroelectrics has, up to now, been characterized solely by the total switching time and the maximum value of the switching current. The present work was aimed at determining how the instantaneous value of the switching current in single crystals of $BaTiO_3$ depends on the applied field, the state of net polarization of the crystal, and possibly other factors. It was found that the switching current density can be expressed as the product of a function of the polarization, $\phi(p)$, and a function of the electric field, $\exp(-\alpha/E)$. The form of the function $\phi(p)$ indicates a predominance of sideways expansion of 180° domains, with an exponentially increasing domain wall velocity. This last result is shown to be in agreement with a picture of domain wall motion by nucleation of new domain wall layers. This interpretation, together

with some details of the switching current pattern, suggests that a crystal, although apparently single-domain, may always retain some small domains of opposite polarization.

621.315.612.4

2107 PIEZOELECTRIC PROPERTIES OF POLY-CRYSTALLINE LEAD TITANATE ZIRCONATE COMPOSITIONS. D.A.Berlincourt, C.Cmolik and H.Jaffe.
Proc. Inst. Radio Engrs, Vol. 48, No. 2, 220-9 (Feb., 1960).

Detailed data are given for the piezoelectric, elastic and dielectric properties of lead titanate zirconate ceramic compositions near the rhombohedral-tetragonal phase boundary. These compositions have markedly higher electromechanical coupling factors, remanent ferroelectric charge, and coercive field, than ceramic barium titanate. Another interesting feature is a pronounced change in the free permitivity ϵ_{33}^{T} by the poling process; this change is in opposite directions for rhombohedral and tetragonal compositions. The dielectric and elastic anisotropy ratios of pooled lead titanate zirconate are much greater than those of barium titanate, indicating a greater degree of alignment of domains during poling.

621.315.614.6

2108 A STUDY OF THERMAL DETERIORATION OF KRAFT PULPS USING A MASS SPECTROMETER.
Y.Saito and T.Hino.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 602-6 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

The gas evolved from Kraft pulp of 3 different degrees of beating was measured when samples were heated at temperatures between 90 and 160°C in oxygen, argon or under vacuum. Although water constituted the greater part of the gases evolved, the quantity of CO_2 + CO was taken as a criterion of degradation. This was more rapid in O_2 than in argon or vacuum, the more heavily beaten pulp giving the faster rate. An activation energy of 25-35 kcal/mole was derived from the temperature dependence of the reaction rate. It was found that the presence of moisture accelerated the process.
K.W.Plessner

621.315.615 : 621.315.2

2109 NON-DRAINING COMPOUNDS AND NON-DRAINING CABLES. K.Brinkmann.
Elektrizitätswirtschaft, Vol. 58, No. 8, 229-33 (April 20, 1959). In German.

Surveys the properties of dielectrics for cable insulation and the composition of non-draining compound-impregnants in paper-insulated cables for use in steep terrain and mine shafts. The correct selection of components for the impregnant gives a compound of good electrical properties, low viscosity at the impregnation temperature and good plasticity at operational temperatures and at low ambient temperatures. The electrical properties of some German and foreign cables are compared. Cables examined under overload conditions, temperature ranges −0.5°C to +63°C, and under short-circuit stress are described. The non-draining cables are becoming used increasingly in mountainous districts, mining areas and in tropical countries with high ambient temperatures. Cables for use up to 25 kV are in use and one of 30 kV is under test. One cable for direct-current voltage operates at 70 kV.
W.A.Walker

621.315.616.9

2110 HEAT-RESISTING P.V.C. FURTHER ADVANCES IN DEVELOPMENT OF WINDING WIRE INSULATION.
F.T.White and P.I.A.Martin.
Elect. Times, Vol. 136, 335-8 (Oct. 8, 1959).

For previous work see Elect. Times, Vol. 131, 431 (March 21, 1957). Progress in the use and development of heat-resisting p.v.c. compounds for use in winding-wire insulation is surveyed. Improved polymeric and high-molecular-weight monomeric plasticizers have introduced a greatly increased retention of flexibility at high temperatures in the hard-grade p.v.c. compounds. The use of plasticizer stabilizing (antioxidant) agents is noted. Improved compounds for varnishing and stoving applications are noted.
W.A.Walker

621.315.616.9

2111 A STUDY OF THE ELECTRICAL STRENGTH OF AIR-STYROFLEX CABLE INSULATION BY THE STATISTICAL METHOD. S.M.Bragin.
Elektrichestvo, 1959, No. 9, 78-83 (Sept.). In Russian.

Investigates type MKSG 4 × 4 × 1.2 mm connecting cable, consisting of 4 quads, each made up of 4 Cu conductors of 1.2 mm diam, insulated by a lay of styroflex cord of diameter 0.8mm and over this, styroflex tape of 0.05 mm thickness. A.C. breakdown is mainly due to gas ionization. The study is mainly mathematical. The effective a.c. limiting voltage is shown to be around 2 kV (giving a probability of breakdown < 0.01%).
D.E.Brown

621.315.616.9

2112 SILICONES AND THEIR APPLICATION IN THE MANUFACTURE OF TRANSFORMERS. H.H.von Stengel.
Elektrotech Z. (E.T.Z.) A, Vol. 80, No. 20, 725-9 (Oct. 11, 1959). In German.

After a brief description of the molecular structure of silicones, their application as an insulating and cooling medium in power transformers is discussed at length and a number of practical examples are given.
H.Norel

621.315.616.9 : 621.315.2

2113 SYNTHETIC MATERIALS IN CABLES AND CABLE FITTINGS. H.Pairitsch.
Elektrotech Z. (E.T.Z.) A, Vol. 80, No. 20, 730-5 (Oct. 11, 1959). In German.

The synthetic materials most commonly used for cable insulation and sheathing and for cast resin joints and terminal boxes are listed and their properties are briefly described. A general account of their present range of application and practical examples of their use are given.
H.Norel.

621.315.616.9

2114 A STUDY OF THE EFFECTS OF CORONA ON POLYETHYLENE. E.J.McMahon, D.E.Maloney and J.R.Perkins.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 654-62 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

The effect of combined mechanical stress and corona was investigated on polyethylene sheet subjected to a 50% elongation. The power-frequency electric stress of 200 V/mil (for most tests) was applied between stainless-steel rods with a curved edge and a plane, the surrounding medium being air, nitrogen or carbon dioxide under controlled humidity. Failure always occured in the annular region adjacent to the rod, where corona was visible. Time to failure decreased very much due to mechanical stress, but increased in the presence of moisture, the best results being obtained in moist nitrogen. Removal of the stress by annealing restored longer lives. After substituting silicone fluid for the gaseous ambient medium no failures were observed even at 1200 V/mil.
K.W.Plessner

MEASURING METHODS
ELECTRICAL TESTING

621.317.32

2115 ACCURATE MEASUREMENT OF VERY SMALL CHANGES IN ALTERNATING VOLTAGES. H.Helke.
Arch. tech. Messen, No. 285, (Ref. V 3331-2), 203-4 (Oct., 1959). In German.

The voltage is applied to a bridge consisting of non-linear and linear resistors so that balance can only be obtained at one particular voltage. By using a sensitive bridge detector, small deviations, of the order of 0.05%, from this particular voltage can be detected. A typical application is the measurement of the stability of alternating voltage stabilizers.
K.W.Plessner

621.317.32

2116 LEVEL STANDARD FOR CONTROL AND CALIBRATION OF ELECTRONIC MEASURING APPARATUS.
A.Salomon.
Ingeniøren B, Vol. 69, No. 2, 94-6 (Jan. 15, 1960). In Danish.

Describes a primary level standard for calibration and measurement of a.c. voltages, which, on account of its accuracy and reliability, is suitable for the calibration of other measuring apparatus. It is based on a directly heated subminiature tube coupled as a saturated diode. Using a saturated diode as a current-measuring element permits a short adjustment time and a high accuracy of reading. The unit can be adjusted to give three different output levels with an accuracy better than 1% in the 0-15 Mc/s range. Its output impedance is 75Ω and it can be used also for measurement of attenuation and frequency response. Built-in overload protection enables it to be used for production control purposes.
G.N.J.Beck

621.317.332.1 : 621.385.032.213.13 : 537.533

2117 NEW METHODS FOR THE MEASUREMENT OF CATHODE INTERFACE IMPEDANCE. H.B.Frost.

I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 315-21 (July, 1959).

Two improved methods for the measurement of cathode interface impedance were developed, and their limitations are analysed. One of these, the complementary network method, is an improvement of a technique disclosed at the 1952 I.R.E. National Convention. The other, the shunt admittance bridge, has not been described previously. Both methods allow the measurement of impedance with both small resistance and short time constant, well below the limit, 50 ohms at 0.1 μsec, of most present equipments. With the development of improved cathode alloys, the measurement of interface impedances having short time constants and low resistances has become important to control this parameter in manufacture and to obtain further improvement. For the complementary-network bridge, the theoretical analysis shows the extreme importance of minimizing stray inductance in the complementary network. When corrections are applied, the complementary-network bridge has good accuracy, with less than one-ohm error at 10 ohms and 0.05 μsec and lower relative errors for higher resistances. The shunt admittance bridge is most satisfactory when tubes with transconductances greater than 104 μmho are to be measured. An impedance transformation is used which allows much easier physical realization of the measurement network than in other interface measurement methods. For tubes with transconductances greater than 104 μmho, the shunt admittance bridge will provide accurate time constant and resistance data down to 0.02 μsec and 5 ohms.

621.317.333 : 621.315.616.9

2118 TESTING TECHNIQUE AND TESTING OF PLASTICS FOR HIGH VOLTAGE ENGINEERING. K.Potthoff.

Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 20, 688-92 (Oct. 11, 1959). In German.

Survey of methods for testing mechanical and electrical properties and locating faults in plastic materials, based on inducing electrical or mechanical oscillations in them. Their response is indicative of the behaviour of the molecules under various conditions and the overall properties of the material can be assessed by integrating results from a series of measurements. Amongst the properties which can be ascertained in this way are the modulus of elasticity, attenuation, dielectric constant, loss angle, puncture voltage, tracking resistance, etc. H.Norel

621.317.333 : 621.315.618

2119 EXPERIENCE WITH THE A.I.E.E. SUBCOMMITTEE TEST CELL FOR GASEOUS INSULATION.

M.L.Manning.

Trans Amer. Inst. Elect. Engrs III, Vol. 78, 800-7 (1959) = Pwr Apparatus Syst., No. 44 (Oct., 1959).

Results of electric strength tests in air, nitrogen, SF_6 and C_3F_8 are reported for various sphere, plane and cylindrical–plane electrode systems, with electrode spacings varying between 0.1 and 0.5 in. It is premature to adopt any one system for assessing the relative electric strength of gases. J.H.Mason

621.317.333.6 : 621.315.2

2120 INSULATION TESTS FOR SHORT LENGTHS OF CABLES ON THE BASIS OF DISCHARGE MEASUREMENTS. B.Długosz.

Energetyka (Poland), Vol. 12, No. 11, 337-40 (1958). In Polish.

Discusses the results of discharge tests at 8.7 and 12 kV on a 30 m length of 15 kV oil-impregnated paper-insulated cable using a tuned-circuit discharge detection circuit with oscillograph display. M.W.Makowski

621.317.333.8 : 621.313.3

2121 THE REFLECTIONS OF IMPULSE WAVES IN MACHINE WINDINGS. B.Kern.

Elektrotech. u. Maschinenbau (E.u.M.), Vol. 76, No. 17, 415-18 (Sept.1); No. 18, 436-41 (Sept. 15, 1959). In German.

The dielectric stresses in the slot insulation of machines during impulse testing can be influenced greatly by the reflection of impulse waves from the winding ends. An attempt is made to calculate the effect of these reflections on the voltages which appear at the machine terminals and at the star point, with various values of winding wave-impedance, input resistance and earthing resistance. Tested voltage–time curves on a 12.5 MVA 5.5 kV turbo-alternator, when compared with calculated curves, show good agreement in shape but fairly large differences in magnitude. These differences are due to various simplifying assumptions and to the fact that the impulse wave-impedances of the windings vary widely with time. This effect is illustrated by test results. A bibliography is included. H.Sterling

621.317.34 : 536.51

2122 MEASUREMENT OF EQUIVALENT NOISE RESISTANCE OF A NOISE THERMOMETER AMPLIFIER.

H.Pursey and E.C.Pyatt.

J. sci. Instrum., Vol. 36, No. 6, 260-4 (June, 1959).

A method is described for the measurement of amplifier noise to an accuracy of better than 1%. The method involves the determination of the ratio of noise due to the amplifier alone, and the noise due to the amplifier and a wire-wound resistance at a standard temperature. Random errors are analysed, and the effects of systematic errors are discussed.

621.317.34 : 621.396.933.2

2123 A METHOD OF PROVIDING TEST SIGNALS OF CALCULABLE STRENGTH FOR AIRBORNE RADIO DIRECTION FINDERS. R.W.Sharples.

Marconi Rev., Vol. 22, 234-9 (Fourth Qtr, 1959).

Possible methods of providing signal inputs of known strength for testing medium- and low-frequency direction finders are discussed. The input to the loop aerial is shown to present the main problem and a method is described in which the loop itself is placed in a magnetic field of known strength. A transmission line carrying a known current is used to provide the magnetic field, the line being mounted inside a screened enclosure. A formula is derived for the magnetic field strength taking into account all the significant dimensions of the screened enclosure. Practical results are given which show that the screened volume can be reduced to a size suitable for portable use without appreciable loss of accuracy.

621.317.34 : 621.397.2

2124 I.R.E. STANDARDS ON TELEVISION : MEASUREMENT OF DIFFERENTIAL GAIN AND DIFFERENTIAL PHASE, 1960.

Proc. Inst. Radio Engrs, Vol. 48, No. 2, 201-8 (Feb., 1960).

621.317.35

2125 AUTOCORRELATION AND CROSSCORRELATION ANALYSIS IN ELECTROENCEPHALOGRAPHY.

J.S.Barlow.

I.R.E. Trans Med. Electronics, Vol. ME-5, No. 3, 179-83 (Sept., 1959).

Autocorrelation and crosscorrelation analysis, which have been used extensively in statistical communication theory in the past few years, can be applied, with certain limitations, to the study of the e.e.g. Autocorrelograms for normal subjects can be classified in several categories, according to the dominant frequency, or frequencies, present, and other parameters. Crosscorrelograms of e.e.g. recordings from different locations on the head permit a comparison of the electrical activity at the two locations. Correlation functions and power-density spectra contain equivalent information because the one may be obtained from the other by Fourier transformation; but, because of the squaring and multiplication that appear in the computation process, the data so obtained are not exact equivalents of the frequency spectra derived from tuned resonators. A special case of crosscorrelation analysis (crosscorrelation of a repetitive signal with a synchronously occurring brief pulse) can be applied to the detection of electric responses evoked by sensory stimulation. This process is equivalent to averaging a large number of individual responses. Illustrative examples, obtained from semi-automatic computers especially designed for the purpose, are given.

621.317.361

2126 THE DISPLAY OF THE FREQUENCY SPECTRUM OF MODULATED h.f. VOLTAGE. J.Czech.

Elektron. Rdsch., Vol. 13, No. 11, 409-10 (Sept., 1959). In German.

The carrier and sidebands of an amplitude-modulated wave are frequency-modulated with a sawtooth frequency sweep synchronized with the oscillograph timebase sweep. The output of the frequency modulator is passed through a receiver with a narrowband i.f. filter to the vertical deflector plates of the c.r.t. The filter includes a Q-multiplying cathode-follower and has a bandwidth of a few hundred c/s. As a compromise between good resolution and a coherent display, a sweep frequency of 0.6 c/s is used. W.G.Stripp

621.317.37 : 537.7

2127 STROBOMETRIC METHOD OF MEASURING THE PHASE ANGLES OF VERY LOW CURRENTS.

S.B.Girvan and D.S.McIlhagger.

J. sci. Instrum., Vol. 36, No. 6, 283–4 (June, 1959).

A simple device for measuring the phase angle of mains-frequency currents with respect to the applied voltage, to an accuracy of ±0.5°. The method was used with currents in the range 0.01 to 10.0 μA but it is not restricted to this range.

621.317.38

2128 THE MEASUREMENT BASIS OF ELECTRICITY SUPPLY METERING. J.W.Skinner.

Proc. Instn Elect. Engrs, Paper 3194 M, publ. Feb., 1960 (Vol. 107 A, 75–82)

The paper has a threefold object. First, to establish the precise significance of 3-phase power, reactive volt-amperes and total volt-amperes, secondly to examine the suitability of these quantities as a basis for a tariff system and thirdly to analyse the possible metering circuits to determine what they actually measure and what are their errors. The accepted definitions of power, reactive volt-amperes and total volt-amperes are established for a single-phase circuit, and the relation between these and the physical conditions of energy flow is examined. The extension of these concepts to 3-phase systems reveals the somewhat arbitrary nature of the quantities which form the basis of many metering systems. Consideration is then given to what a metering system should attempt to measure and whether the integrated values of watt-hours, reactive volt-ampere-hours and total volt-ampere-hours, together with some indication of amximum demand, give adequate information for the assesment of tariff charges. The analysis of 3-phase metering circuits is made in terms of symmetrical-component theory. The possible circuits are tabulated and the total measured quantity is specified as a function of the power and reactive volt-amperes of the positive-, negative- and zero-sequence components. By comparing these data with the symmetrical components actually present under any particular conditions, the suitability of the methods of measurement and their errors are readily derived.

621.317.39

2129 DEVELOPMENT OF AN ELECTRONIC DIFFERENTIAL PRESSURE TRANSMITTER FOR FLOW MONITORING AND CONTROL. D.J.Aldinger and H.Stultz.

A.I.E.E. Analog and Digital Instrumentation Conference Paper, p. 165–82. See Abstr. 3875 (1959).

A design analysis of a pressure transducer the two inputs to which are connected each to one side of two separate diaphragms. The other sides of the diaphragms communicate with a space filled with liquid, which is itself divided into two by means of a bellows. The bellows is much smaller than the diaphragms and so moves by a very much greater amount than the diaphragms, amplifying the movement hydraulically. The bellows in turn is attached to the core of a linear differential transformer, giving an a.c. output. Appendices give the mathematics of the design, and the instrument specification; an output of 0.2 V a.c. corresponds to a range which may be adjusted as desired between 50 and 200 inch water gauge.

G.A.Montgomerie

621.317.39

2130 A METHOD OF MEASURING LOW FLOW RESISTANCE. W.Wöhle and K.Weber.

Hochfrequenztech. u. ElektroAkust., Vol. 68, No. 5, 158–62 (Dec., 1959). In German.

The specimen whose resistance is to be determined is placed inside a cylinder and gas is driven through it by a piston which is driven to and fro at speeds ranging from ½ to 2 c/s. The difference in pressure of the gas on opposite sides of the specimen is measured by a differential microphone. Because of the low frequency of the change of gas pressure, the capacitance of the microphone changes slowly and is used to modulate a bridge circuit supplied at 10 kc/s. The apparatus is calibrated by using a specimen of known resistance. It is claimed that the technique is superior to that employing unidirectional flow in that it permits usage of a sensitive microphone for recording pressure differences and the signals from it are amplified. The smallest acoustic resistance which can be recorded by this technique is 100 N/m^5 and at these low values the error is of the order of 10%.

A.C.Whiffin

621.317.39

2131 ELECTRONICS ASSISTS IN HIGHWAY CONSTRUCTION. H.Harris.

Electronics, Vol. 32, No. 51, 69–71 (Dec. 18, 1959).

Details are given of some of the equipment developed for making measurements on an experimental road built by the American Association of State Highway Officials. The transient deflection of the road under the wheel of a moving vehicle is measured by differential transformers, while strains inside concrete slabs are recorded by resistance strain-gauge units. The deflection of the road surface under a standard wheel load is measured by a Benkelman beam which records the difference in height of a point near the wheel when the vehicle is stationary and moved away. Longitudinal and transverse profiles of the road are recorded by equipment energized by the signal depending upon the slope of the linkage between two adjacent recording wheels. The signals are integrated, digitized, and then recorded on punched tape. The density and moisture content of the various layers laid during construction of the road were determined by radioactive apparatus in which the back-scattering of gamma radiation was used to measure density and the scattering of neutrons to measure moisture content. The paper gives only general details and not full information concerning the various items mentioned.

A.C.Whiffin

621.317.39

2132 ELECTRO-MECHANICAL TRANSDUCERS FOR AN ELECTRIC CONTROL SYSTEM.

R.Dallimonti and J.O.Johnson.

A.I.E.E. Analog and Digital Instrumentation Conference Paper, p. 183–95. See Abstr. 3875 (1959).

A force-to-current transducer employs a pivoted beam to balance the input force against the force generated in a coil through which the output current flows and which is in the field of a permanent magnet. Slight movement of the beam is detected by an inductance controlling a transistor oscillator at a frequency of 50–70 kc/s: the rectified oscillator output provides the current for the instrument output and for the force coil. Current-to-force linearity is better than 0.1%, hysteresis better than 0.05%, for a current range of 4–20 mA. If the input is a movement rather than a force, it is first translated into a force by means of a spring, and with this addition the transducer can be attached to a number of basic process variable measuring devices, such as: flow meters with deflecting bellows or force-balanced diaphragm; pressure gauges with deflecting Bourdon tube, bellows, or diaphragm; and deflecting liquid-level float or force-output devices.

G.A.Montgomerie

621.317.39

2133 PIEZOELECTRIC VIBRATION PICK-OFFS. W.Erler and A.Lenk.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 2, 64–74 (July, 1959). In German.

The use of quartz instead of barium titanate as a strain sensitive material is an advantage when operation at high temperatures is required. The elements are normally employed as thickness vibrators or in the flexural mode. Examples are given of commercial pick-offs for measuring both acceleration and vibration amplitude. The relevant calculations for each type and for each situation are explained. One model represents an improved replacement for an existing $BaTiO_3$ accelerometer for frequencies up to 15 kc/s. Three other types use the flexural mode, one of which has a particularly small mass (4 g) and another is specially sensitive (110 mV/ms^{-2}) with a low resonant frequency. All these models are useful between 3–15 kc/s.

S.C.Dunn

621.317.39

2134 A TACHOMETER WITH A HIGH SHORT-TERM ACCURACY. C.Reed.

Electronic Engng, Vol. 32, 103–5 (Feb., 1960).

An alternator speed-measuring instrument is described in which speed, within a range of approximate ±10% of a nominal, is indicated. The method used results in a linear scale and can be adapted for other nominal speeds and ranges. Accuracy is maintained by a built-in crystal-controlled oscillator and calibration is easily checked and adjusted. Some refinements are suggested.

621.317.39

2135 SOME PRACTICAL APPLICATIONS OF THE ELECTRO-MAGNETIC NOZZLE FOR THE MEASUREMENT OF LOW VELOCITIES [OF LIQUIDS]. Hermant and Wolf.

Houille blanche, Vol. 14, No. 1B, 883–91 (Dec., 1959). In French.

Describes the working principle of an instrument for measuring the flow velocity of a liquid by means of the electric field induced in it by a magnetic field. A brief description of the electromagnetic

nozzle embodying this principle is given. It is designed to measure very low velocities, ranging from 1 to 100 mm/sec. Examples are given of applications to the measurement of leakage through the gates of a small dam, to leakage through a turbine distributor and to leakage in the headrace tunnel of a hydroelectric power station.

621.317.39 : 531.76

2136 PHOTOELECTRIC APPARATUS FOR MEASURING VELOCITY. A.C.Gray and S.Thomas.

J. sci. Instrum., Vol. 36, No. 7, 305-6 (July, 1959).

The apparatus caters for projectiles 1-5 cm in diameter with velocities of 700-3500 cm/sec. The accuracy of measurement is approximately ±0.2%.

621.317.39 : 531.78

2137 TRANSMISSION DYNAMOMETERS. E.P.Kingsbury.

Rev. sci. Instrum., Vol. 130, No. 11, 1068 (Nov., 1959).

Proposes the use of two sine generators mounted a distance apart on the shaft so that when the shaft is carrying no torque the outputs are 180° out of phase. The generators are connected in series and the voltage developed is directly proportional to the power transmitted. E.G.Knowles

621.317.39 : 621.385.1

2138 MEASURING THE THERMAL EMISSIVITY OF STRIP MATERIALS. D.R.Kerstetter.

Sylvania Technol., Vol. 12, No. 4, 118-20 (Oct., 1959).

A new method and apparatus are described for the rapid measurement of the thermal emission of sheet materials such as those used for the fabrication of tube electrodes. The equipment consists essentially of a chamber, heat lamp, thermocouple and thermometer. The temperature of the sample is measured with one side blackened and with both sides blackened. When the data are placed in the expression for the Stefan-Boltzmann law, the emissivity of the surface not blackened is obtained. Testing time is about 10 minutes per sample, and the reproducibility is one to two percent.

621.317.39 : 536.5

2139 TECHNIQUES OF CATHODE TEMPERATURE MEASUREMENTS AS APPLIED TO COMMERCIAL CATHODE-RAY TUBES. P.P.Coppola.

Rev. sci. Instrum., Vol. 31, No. 2, 137-43 (Feb., 1960).

Thermocouple, optical pyrometer, and retarding potential techniques for the measurement of cathode temperatures have been investigated to determine their relative merits, limitations, and corrections. The thermocouple method is accurate and reliable provided necessary lead loss corrections are made. Application of this method to commercial tubes is limited by the expense involved. The optical pyrometer method is questionable when applied to an oxide-cathode coating due to considerable spread in spectral emissivity data; however, the method is reliable when applied to the cathode base nickel. The retarding potential method shows good correlation to the other methods and is directly applicable to commercial tubes with no modifications required. However, limitations are imposed by a number of factors, notably the stability of cathode emission and leakage current levels.

621.317.39 : 536.53

2140 RESISTANCE THERMOMETER SPEAR FOR FIELD MEASUREMENT. A.C.Jason and A.Lees.

J. sci. Instrum., Vol. 36, No. 6, 272-4 (June, 1959).

The instrument described measures temperatures in the range − 30° to + 70° F with an accuracy of ± 0.2° F. The sensitive portion consists of a copper wire spiral enclosed in a length of hypodermic tubing; the resistance is measured on a Wheatstone bridge. The instrument is cheap, reliable, robust and self-contained.

621.317.39

2141 UNDERWATER ECHO-RANGING WITH ELECTRONIC SECTOR SCANNING: SEA TRIALS ON R.R.S. DISCOVERY II.

D.G.Tucker, V.G.Welsby, L. Kay, M.J.Tucker, A.R.Stubbs and J.G.Henderson.

J. Brit. Instn Radio Engrs, Vol. 19, No. 11, 681-96 (Nov., 1959).

Sea trials of an electronic sector-scanning asdic equipment were conducted during October 1958 in R.R.S. Discovery II with the particular purpose of determining the general performance of the equipment and its ability to detect and give information relating to fish shoals. A description is given of the design of the equipment and of the results obtained. It is shown that very considerable success was achieved.

621.317.39 : 621.395.625

MEASUREMENT OF WOW BY MEANS OF A FLUCTUOMETER. See Abstr. 1791

621.317.39 : 621.791

A RECOMMENDED PROGRAM FOR RESISTANCE-WELDING INSTRUMENTATION. See Abstr. 1964

621.317.4 : 621.314.2

2142 MEASUREMENTS ON ELECTRICAL SHEETS IN THE LABORATORY AND IN MANUFACTURE. W.Krug.

Elektrotech. Z. (E.T.Z.) A, Vol. 80 No. 17, 593-9 (Sept. 1, 1959). In German.

Discusses methods of measuring the magnetic parameters of sheets of material. R.C.Glass

621.317.42

2143 MEASUREMENT OF THE FREQUENCY OF MAGNETIC INDUCTION AND ITS STABILITY IN TIME. C.Fric and H.Hahn.

C.R.Acad. Sci. (Paris), Vol. 250, No. 4, 680-2 (Jan. 25, 1960). In French.

The magnetic field of an electromagnet is measured by observing the frequency of an oscillator of the maser type (Abstr. 5749 of 1958). An accuracy of 1 in 10^7 is claimed and an advantage is that the spatial homogeneity does not need to be high. D.J.Oliver

621.317.44

2144 CURRENT PULSE GENERATOR TESTS MAGNETIC CORES. H.W.Goss.

Electronics, Vol. 33, No. 1, 80-1 (Jan. 1, 1960).

Describes a current pulse generator for testing ferrite memory cores having a wide range of input requirements. The capabilities of the system include repetition rates up to 20 kc/s, pulse durations from 0.5 to 12 μs, amplitudes from 200 mA to 3 A and linear rise-time from 200 mμs to 0.5 μ. R.C.Glass

621.317.44 : 620.1

2145 NEW TYPE OF SEARCH COIL FOR METAL-PIPE LOCATION. J.A.Phillips.

J. sci. Instrum., Vol. 36, No. 9, 399-400 (Sept., 1959).

A method of tracing metal pipes, involving the amplification of the voltage induced in a special type of search coil by transient currents injected into the pipe, is described. The search coil consists of two identical flat coils mounted side by side in the same plane, and so connected that the output voltage is equal to the difference of the voltages induced in the two coils. An audible signal is obtained in headphones after amplification of the output voltage It is found that, with this twin coil system, the signal strength varies approximately as $1/R^3$, where R is the perpendicular distance from the pipe to the search coil, and that a more reliable performance is obtained compared with the usual single type of search coil.

621.317.44 : 538

2146 A ROCKET-BORNE MAGNETOMETER. K.Burrows.

J. Brit. Instn Radio Engrs, Vol. 19, No. 12, 769-76 (Dec., 1959).

The geophysical reasons for requiring magnetic measurements in the upper atmosphere and the general and instrumental considerations involved in using a Skylark rocket for the purpose are outlined. The principles of the measuring technique employing a proton precession magnetometer and the reasons for its selection are discussed. The application of these principles to the design, construction and testing of a practical instrument are described.

621.317.44 : 538

2147 SENSITIVE RECORDING MAGNETIC FLUXMETER. P.Lerond and A.Thulin.

J. sci. Instrum., Vol. 36, No. 9, 388-9 (Sept., 1959).

The fluxmeter described uses a taut-suspension galvanometer, the torque of which is compensated by positive feedback. This latter is furnished by a servo-operated potentiometer, the wiper of which follows the motion of the galvanometer light spot. The device is an adaptation of a commercially available recorder and permits recording of flux-variations as low as 100 Maxwell-turns per second.

621.317.44 : 538.08

2148 TIM; A BRUSHLESS GENERATING MAGNETOMETER. C.W.McCutchen.

J. sci. Instrum., Vol. 36, No. 11, 471-4 (Nov., 1959).

TIM (the turbo-inductor magnetometer) is an air-driven generating magnetometer which uses inductive output to avoid brushes and slip rings. The resulting mechanical simplicity allows this magnetometer to be made very small while the high rotation speed, which is possible because there are no brushes, makes the magnetometer quite sensitive. It is most suitable for measuring static of very nearly static magnetic fields. The output is an audiofrequency signal, and the accuracy depends chiefly on how accurately the amplitude and frequency of that signal are measured.

621.317.44 : 538

2149 STABILIZED TORQUE MAGNETOMETER. W.F.Archenhold, A.C.Brown and J.E.Thompson.

J. sci. Instrum., Vol. 36, No. 12, 505-6 (Dec., 1959).

An improved torque magnetometer has been developed which enables measurements of torque to be made with high precision and under conditions of complete stability. The specimen torque is balanced by means of an electric current passing through the coil of a moving coil meter movement, which replaces the normal torsion head and wire. A small permanent magnet is mounted on an extended movement pointer, so that one pole is capable of restricted motion in the field of two opposing current carrying coils, which provide the necessary stability. The principle employed for producing stability is capable of application to fields other than magnetism.

621.317.49

2150 A LOW-CONDUCTIVITY MAGNETIC FLOWMETER. D.R.Lynch.

Control Engng, Vol. 6, No. 12, 122-3 (Dec., 1959).

Consists of a flow transducer in the form of an a.c. generator connected to a suitable amplifying system with the conducting liquid acting as the driving armature. Analysis of the amplifier shows that by restricting the capacitance of the cables, using twin-shielded electrode cables and maintaining the inner shields slightly above the conductor potential, the main transformer capacitance can be neutralized. It is claimed that the meter is suitable for liquids of 0.1×10^{-6} mho specific conductivity. R.W.J.Cockram

621.317.61

2151 AUTOMATIC MEASUREMENT OF TRANSISTOR BETA. E.P.Hojak.

Electronics, Vol. 32, No. 49, 114-15 (Dec. 4, 1959).

A circuit using two n-p-n (or p-n-p) transistors is used to maintain a specified d.c. collector current in the p-n-p (or, correspondingly, n-p-n) transistor on test while the d.c. base current is measured to give the d.c. beta. F.F.Roberts

621.317.61 : 621.382

2152 FURTHER CONSIDERATION OF BULK LIFETIME MEASUREMENT WITH A MICROWAVE ELECTRODELESS TECHNIQUE. H.Jacobs, A.P.Ramsa and F.A.Brand.

Proc. Inst. Radio Engrs, Vol. 48, No. 2, 229-33 (Feb., 1960).

A new method for measurement of the lifetime of excess carriers in semiconductors is described. Using a steady light source and measuring changes in microwave power absorption as a function of position of the sample in a waveguide, bulk lifetime can be determined. Measurements described were made at 9600 Mc/s. The new technique offers the following advantages: first, the method does not require electrode attachments, thus making the preparation of the samples less difficult and the actual experiment less subject to error due to non-ohmic contacts; second, the effects of surface recombination are made less important, thus giving a greater assurance of the evaluation of bulk lifetime.

621.317.61 : 621.382.333

2153 RADIO-FREQUENCY MEASUREMENTS ON TRANSISTORS. F.J.Hyde.

Proc. Instn Elect. Engrs, Paper 3127 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106 B, Suppl. 17, 942-4, 1009-11 (1959).

R.f. methods are described for measuring the internal current gain, the collector and emitter depletion-layer capacitances, and the ohmic base resistance of alloy-type transistors. A biased thermistor is used as a continuously variable r.f. resistance. J.B.Birks

621.317.61

2154 THE APPLICATION OF SURFACE-MEASUREMENT TECHNIQUES TO TRANSISTORS. J.R.A.Beale, D.E.Thomas and T.B.Watkins.

Proc. Instn Elect. Engrs, Paper 3081 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1004-8, 1009-11 (1959).

The principle of a method for studying the recombination surface of a transistor has been described in a previous paper. Here, the physical concepts on which the method is based are discussed, and how it may be applied, in conjunction with other techniques, to the systematic study of the effects of any surface treatment. Some practical details of the apparatus and techniques are described and the value of the method is illustrated by an example.

621.317.61 : 621.382.3

2155 DETERMINATION OF PHYSICAL PARAMETERS AND GEOMETRY OF A JUNCTION TRASISTOR. S.Deb and A.N.Daw.

Proc. Instn Elect. Engrs, Paper 3041 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1033-7, 1072-4 (1959).

An investigation is made of the problem of determining the physical parameters and geometrical dimensions of a junction transistor from measurements of its equivalent circuit parameters. It is shown that simple manipulations of certain known relations in the theory of low-level transistor operation provide a method of determining to a reasonable degree of accuracy the values of lifetime, diffusion constant and mobility of injected carriers in the base region, the carrier concentrations in the emitter, base and collector regions, the base width and the effective junction areas. Methods involving consideration of certain aspects of high-level operation are also discussed for estimating the probable values of lifetime and mobility of minority carriers in the emitter and collector regions and also the volume and surface recombination lifetimes of such carriers in the base region. Representative experimental results obtained by the method under low-level operating conditions are described, and the accuracies of a few of these are checked by comparison with known values. The reliability and the general usefulness of the method of measurement are briefly discussed.

621.317.619 : 621.382

2156 THE MEASUREMENT OF TRANSISTOR CHARACTERISTICS AT VERY HIGH FREQUENCIES. J.H.Bagley.

Proc. Instn Elect. Engrs, Paper 3019 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 945-50, 1009-11 (1959).

Discusses the evaluation of transistors suitable for use as small-signal v.h.f. amplifiers. Parameters governing behaviour at very high frequencies are discussed and measurement techniques are described. Results of measurements at 100 Mc/s on two types of v.h.f. transistor are given; from these data, maximum available power gains are calculated and compared with values measured in a practical amplifier circuit.

INSTRUMENTS
MEASURING APPARATUS

621.317.7

2157 IS THE ZERO OUTPUT REALLY ZERO? L.P.Entin.

Control Engng, Vol. 6, No. 12, 95-8 (Dec., 1959).

A discussion of the difficulties in deciding and specifying the allowable uncertainties of zero in instruments, particularly the more complex electromechanical types. The example considered is a rate gyro, and the zero errors are those due to manufacturing misalignments, ambient temperature variations and mechanical hysteresis. C.F.Pizzey

621.317.715

2158 DEFLECTION AND ZERO STABILITY OF RIBBON AND TAUT RIBBON SUSPENSIONS. II. E.Samal.

Arch. tech. Messen, No. 282 (Ref. J. 013-9), 149-50 (July, 1959). In German.

For Pt I see Abstr. 5196 (1959). Using the instrument described in Pt I, the hysteresis and after-effect of a number of alloy ribbons

are determined as a function of shear stress during deflection, the time for which the deflection is maintained, and the time since return to zero. In conclusion, some pointers are given on the best methods of achieving zero stability. K.W.Plessner

621.317.715 : 537.7

2159 GALVANOMETER FEEDBACK SYSTEMS. J.A.Sirs.
J. sci. Instrum., Vol. 36, No. 5, 223-7 (May, 1959).

The principles of applying feedback to a galvanometer, after optical and electronic amplification, are discussed. In particular, the galvanometer performance is examined when proportional, differential, compound and selective feedback systems are used. The latter method is compared with mechanical and series-capacitor tuning of the galvanometer response.

621.317.72

2160 MULTIPLE INSTRUMENTS FOR MEASUREMENT OF ALTERNATING CURRENT VALUES OF MAGNITUDE AND PHASE. M.Sangl.
Arch. tech. Messen, No. 281, (Ref. V 3631-9), 113-16 (June, 1959). In German.

The instruments described are of the rectifier type and are based on two different measuring principles. In the first group the phase angle is derived from a current-sum or a current-difference measurement. Using the difference principle, V and A and their vector difference (D) are measured, the voltage and current circuits of the instrument being interconnected for D. Cos ϕ is then given by $(V^2 + A^2 - D^2)/2VA$. (See Abstr. 1400 of 1951). In the second group the phase angle is derived from current-sum and current-difference measurements, i.e. $(V + A) - (V - A)$. In both expressions V represents a current in phase with and $\propto$ voltage. An instrument based on the second principle is described which indicates V, A, cos ϕ and sin ϕ directly, and is provided with additional circuits for indicating frequency (range 40-400 and 400-4000 c/s), and resistance up to 100 kΩ (3 ranges). The ohmmeter is energized by an internal battery. C.F.Pizzey

621.317.723

2161 ELECTROMETER MEASURING APPARATUS FOR INDUSTRIAL USE. I-II. H.Böhm.
Arch. tech. Messen, No. 283 (Ref. J 8335-9), 169-72 (Aug.); No. 285 (Ref. J 8335-10), 217-20 (Oct., 1959). In German.

The forms of electrometer considered are the vibrating-capacitor type and the thermionic-valve type. The characteristics and applications of the various forms of input circuit, the limits of voltage and current sensitivity, zero and calibration drift, types of amplifier for the two forms of electrometer, use of negative feedback, the stabilization of supplies, are discussed in detail. A brief list is given, including details of performance, of electrometers of both types which are commercially available. C.F.Pizzey

621.317.723 : 621.375.43

2162 A MULTI-RANGE ELECTROMETER AMPLIFIER USING VARIABLE FEEDBACK. J.H.Leck and W.E.Austin.
Electronic Engng, Vol. 32, 106-7 (Feb., 1960).

The simple electrometer amplifier which is described has been found both accurate and reliable over a period of twelve months for the measurement of positive ion currents down to 10^{-15} A. By using a modern miniature electrometer valve in conjunction with a high-gain transistor d.c. amplifier having a large overall negative feedback, the advantage of simplicity is combined with that of high accuracy and adequate sensitivity. The inherent disadvantage of the transistor d.c. amplifier, its temperature instability, has been overcome in this application by using a silicon transistor in the first stage and operating with an input from a constant current source.

621.317.723 : 537.7

2163 ELECTROMETER FOR MEASURING THE VARIATION WITH CONCENTRATION OF THE LOW FREQUENCY DIELECTRIC CONSTANT OF AQUEOUS IONIC SOLUTIONS. V.I.Little.
J. sci. Instrum., Vol. 36, No. 3, 129-32 (March, 1959).

A new electrometer is described which enables measurements to be made of the dielectric constants of aqueous ionic liquids, in terms of that of pure water, up to concentrations of about 10^{-2}N. The method depends on the observation of a null point when two couples acting upon an electrode suspended in the liquid are equal. One couple depends on electric forces and varies directly with the dielectric constant, whilst the other couple is magnetic and may be made proportional to the value of an external resistance. The probable error in the final results is of the order 0.5%.

621.317.727.2

2164 POTENTIOMETER RECORDERS WITH CONTINUOUS BALANCE. I. ELECTRICAL PARTS AND THEIR MODES OF WORKING. II. NULL BALANCE AND DAMPING CIRCUITS. III. MECHANICAL CONSTRUCTION OF STRIP-CHART RECORDERS. G.Langhürig.
Arch. tech. Messen, No. 281, (Ref. J 034-5), 121-4 (June); No. 284, (Ref. J 034-6), 185-8 (Sept.); No. 285, (Ref. J 034-7), 209-12 (Oct., 1959). In German.

The recorders described are mostly of the slide-wire type with d.c.–a.c. inverters and 2-ph. servomotor balancing systems, and are of U.S.A., Dutch or German manufacture. Pt I discusses principles of operation, inverters, including contact (chopper) types, the vibrating reed (capacitor) type, and a semiconductor type based on the Hall effect, amplifiers, 2-ph. motors and reduction gearing. Pt II discusses the balancing process, factors which determine width of the dead zone and speed of balancing, damping systems using eddy currents induced in the rotor of the motor, and systems using tachogenerator damping. Three instruments which employ unusual methods of balancing are described. The first uses variable-capacitor balancing with double solenoid drive; the second is the General Electric (U.S.A.) recorder incorporating the so-called Magnetic Standard which is balanced by a permanent magnet rotated through a small angle by a 2-ph. motor; the third is the Keinath Sweep Balance recorder. Pt III describes switch-operating mechanism for multi-point recorders, colour change and numbering mechanism for chart marking, and speed change mechanism for chart drives. C.F.Pizzey

621.317.727.2 : 537.7

2165 ELECTROLYTIC POTENTIOMETER AS A GENERAL PURPOSE PHYSIOLOGICAL TRANSDUCER. W.G.Whittlestone.
J. sci. Instrum., Vol. 36, No. 1, 8-11 (Jan., 1959).

The use of the electrolytic potentiometer as a transducer for physiological measurements is described. Two suitable types of amplifier circuit are given; one in which the output from the electrolytic cell drives a cathode follower as a stable power amplifier, and another in which a second electrolytic cell is coupled to a recording milliammeter, and the latter used as a phase sensitive servo-motor to balance changes in the measuring cell. A transistor amplifier circuit suitable for portable equipment is given as part of the second application.

621.317.73 : 537.7

2166 SIMPLE APPARATUS FOR MEASURING DIELECTRIC CONSTANTS AND LOSSES FROM 10 c/s TO 50 kc/s. J.C.S.Richards.
J. sci. Instrum., Vol. 36, No. 1, 22-3 (Jan., 1959).

A simple bridge circuit is used with a battery-operated detector. No coupling transformers or Wagner earth adjustments are required. The dielectric constant is measured by a substitution method, and the losses in terms of the equivalent parallel resistance.

621.317.73 : 531.71

2167 INDUCTANCE BRIDGE FOR SENSITIVE DISPLACEMENT MEASUREMENTS OVER LONG PERIODS. D.Murray.
J. sci. Instrum., Vol. 36, No. 7, 312-15 (July, 1959).

An application of linear differential transformers in an a.c. bridge that provides reproducible displacement measurements over long periods, extends the linear response whilst retaining high sensitivity, and can be readily adapted for automatic recording of displacement.

621.317.735

2168 DISCHARGE MEASUREMENTS IN HIGH VOLTAGE DIELECTRICS. E.Schühlein.
Electrotech. Z. (E.T.Z.) A, Vol. 80, No. 22, 777-83 (Nov. 11, 1959). In German.

Describes a portable discharge detector, using resistance coupling to the test sample, an amplifier tuned to 1.9±0.1 Mc/s and a meter indicator. No provision is made for calibrating the sensitivity at the time of use. J.H.Mason

621.317.735 : 537.2

2169 IMPROVED CIRCUIT FOR THE MEASUREMENT OF THE DIELECTRIC CONSTANTS OF GASES. E.J.Gauss and T.S.Gilman.
Rev. sci. Instrum., Vol. 31, No. 2, 164-5 (Feb., 1960).

Chien's apparatus [Journal of Chemical Education, Vol. 24, 494 (1947)] for the measurement of dielectric constants has been modified by the use of a Clapp oscillator. The measuring cell and the technique used to detect capacitance differences of about 10^{-3} pF are described.

621.317.74 : 621.372.2

2170 A SLOTTED LECHER LINE FOR IMPEDANCE MEASUREMENTS IN THE METRIC AND DECIMETRIC WAVE BANDS. G. Schiefer.
Philips tech. Rev., Vol. 21, No. 3, 88-91 (1959-60).

For impedance measurements on balanced objects in the v.h.f. bands (80-300 Mc/s), a balanced, screened transmission line about 2 m long was designed. The characteristic impedance is approx 105 ohms. The probe is insensitive to unsymmetrical waves, the detector diode (type OA95) being introduced directly into the r.f. field inside the line. The supply voltage is modulated in amplitude at 1000 c/s. The total sensitivity in such that, at a supply voltage of 5 V and an s.w.r. of some hundreds, the voltage minima can still be accurately measured.

621.317.75 : 537.533

2171 SIMPLE, HIGH-SWEEP-SPEED, SINGLE STROKE OSCILLOSCOPE. W.P.Baker.
J. sci. Instrum., Vol. 36, No. 1, 30-1 (Jan., 1959).

A considerable simplification of a high-sweep-speed single stroke oscilloscope is shown to result from the application of the accelerating voltage to the tube in the form of a long-tailed pulse. Apart from the power pack the oscilloscope does not incorporate any thermionic valves.

621.317.75 : 681.142

2 A NEW CONCEPT OF ANALOG RECORDING.
See Abstr. 1946

621.317.755 : 537.7

2172 PHOTOGRAPHIC METHOD FOR PULSE AMPLITUDE ANALYSIS. P.J.Kennedy and P.J.Dean.
J. sci. Instrum., Vol. 36, No. 3, 126-9 (March, 1959).

A method is described by which pulse height spectra may be obtained by photographing a c.r.o. display, in which only the tops of the pulses appear on the screen. The time base is switched off and the exposure is adjusted to permit the film to integrate the blackening due to a large number of individual pulse tops. The density variation on the film may be shown to be closely related to the pulse height spectrum and may be obtained from a densitometer measurement. Full details are given of the circuits used to obtain such a display, together with a summary of the applications to which the technique is particularly suited.

621.317.77

2173 AN INSTRUMENT FOR MEASURING THE PHASE SHIFT, INSERTION LOSS AND GAIN IN THE FREQUENCY RANGE FROM 20 kc/s TO 5 Mc/s. K.Sofronov.
Slaboproudy Obzor, Vol. 20, No. 12, 762-7 (1959). In Czech.

The instrument comprises two parallel channels X and N, which are fed from the same signal generator. The measured quadripole is connected to the input of the channel X. Each channel contains a mixer, in which the input frequency is changed to f_z = 15 kc/s; the mixers are followed by low-pass filters which eliminate the higher harmonics. The channel X filter is followed by a variable attenuator T_X. Similarly, channel N has an attenuator T_n. T_X and T_n are followed by amplifiers whose outputs are connected to a differential amplitude-detector D_n. The amplifier outputs are also applied to variable phase shifters P_X and P_n. The outputs of these are fed to a phase detector D_y. D_n determines the difference between the voltage amplitudes. By adjusting T_X, the difference is reduced to zero and the insertion loss can be read directly from T_X. Similarly, by balancing D_y, the phase shift can be determined from the setting of P_X. A general description of the instrument is given.
R.S.Sidorowicz

621.317.788

2174 DYNAMOMETER BALANCE FOR THE DIRECT MEASUREMENT OF THE TORQUE AND MECHANICAL LOAD OF MOTORS. H.G.Gerlach.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 19, 654-8 (Oct. 1, 1959). In German.

A detailed description of a d.c. dynamometer balance suitable for rapid routine measurements of efficiency and for the torque curves of induction motors is given. The mechanical relationships are dealt with mathematically with particular reference to damping. The electrical circuit to give direct readings of torque and power on meters is developed. Several ranges are provided from 5 to 100 m kg.
R.G.Jakeman

621.317.79 : 539.215

2175 MULTI-CHANNEL PHOTOELECTRIC SCANNING INSTRUMENT FOR SIZING MICROSCOPIC PARTICLES. B.B.Morgan and E.W.Meyer.
J. sci. Instrum., Vol. 36, No. 12, 492-501 (Dec., 1959).

Development of a photoelectric scanning instrument for counting and sizing particles dispersed on a microscope slide has continued and the performance of a five-channel version has been assessed. The size distributions of a number of fractions of coal particles of sizes down to 1.5 μ determined by the instrument agree (to within 15%) with those from visual counts. Comparative sizings are given also of alumina particles (5 to 20 μ) and of transparent profiles in an opaque film (5 to 20 μ). Comparative counts are given of the number of particles 1 to 5 μ in thermal precipitator samples of coal. Data are presented on the reproducibility of instrument sizings and an indication is given of the time needed for a determination.

621.317.79

2176 INVESTIGATION ON PROGRAMME METERS. S.N.Salgarkar and N.K.D.Choudhury.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 3, 140-5 (June, 1959).

Two standard instruments are described, a peak reading instrument and VU meter which is an r.m.s. type of instrument. The difference in the two meters is essentially that of degree only and since the meters serve two separate but complementary purposes of programme monitoring, errors are involved owing to fulfilment of any one condition in preference to others. By statistically analysing records of levels registered by the VU meter and the peak meter for identical fragments of Indian programmes, the loss of dynamic range in monitoring a programme by VU meter (in preference to a peak meter) is estimated to range from 4 to 7 dB, depending on the nature of programmes, under identical conditions.

621.317.79 : 621.382

2177 A RESISTANCE-NETWORK ANALYSIS OF THE CURRENT GAIN OF JUNCTION TRANSISTORS. F.C.Gair, R.C.V.Macario and R.L.Rouse.
Proc. Instn Elect. Engrs, Paper 2981 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106 B, Suppl. 14, 1038-45, 1072-4 (1959).

Describes an investigation concerning the variation of the current gain of homogeneous-base junction transistors with recombination conditions and geometrical shape, using a resistance network as a direct analogue. The basic equations which govern the flow of minority carriers in a transistor with a cylindrically symmetrical shape, in the presence of both surface and volume recombination, are established in a form which is directly analogous to a resistance network arrangement as described by Liebmann (Abstr. 4387 of 1953). The transistor action may then be studied conveniently. In the first instance the steady-state solution has been investigated for a representative model, very much like that of the medium-frequency p–n–p alloyed-junction device, and the dependence of the current gain of the transistor on both recombination and geometrical configuration is established. A large number of measurements on the analogue for both normal and inverse operation of the transistor is illustrated by plotting the common-emitter current-transfer ratio against the various transistor parameters. Additional results showing distribution of the surface recombination current density over the surface of the base are given. The resistance network permits the solution to be read directly off the analogue and facilitates the extension to other geometries and types of transistor.

621.317.794 : 536.3

2178 HIGH-SPEED BOLOMETER. H.E.Stubbs and R.G.Phillips.
Rev. sci. Instrum., Vol. 31, No. 2, 115-18 (Feb., 1960).

Intended for measuring the radiation from nuclear fireballs. The bolometer is made by successive depositions of an insulating layer and a gold sensing element upon a copper block which serves as a heat sink. An analysis of the bolometer's performance indicates that it has a response time of approximately 50 μsec.

MAGNETIC DEVICES AND MATERIALS

621.318.1

2179 THE ROLE OF MAGNETIC AFTER-EFFECT IN ENGINEERING MATERIALS. K.Sixtus.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 17, 565-70 (Sept. 1, 1959). In German.

Reviews the different types and causes of magnetic after-effect and discusses metallurgical and magnetic ageing in permanent magnets and soft magnetic materials for relays and transformers. After-effect may occur as a result of the diffusion of foreign atoms or electrons (e.g. in ferrites) while fluctuation after-effect of thermal origin is present in all materials. Resonance phenomena due to electron spin are important at very high frequencies.
R.C.Glass

621.318.1 : 621.395.72

2180 METALLIC MAGNETIC MATERIALS AND CORE SHAPES IN TELECOMMUNICATION ENGINEERING. R.Boll.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 17, 582-8 (Sept. 1, 1959). In German.

The uses of magnetic materials in telecommunications and the importance of suitable core shapes are discussed. Materials and core shapes for relays, mains transformers, miniature repeaters, distortion-free repeaters, pulse transmitters and transformers and other applications are described.
R.C.Glass

621.318.1 : 621.374.32 : 538

MILLIMICROSECOND MAGNETIC SWITCHING AND STORAGE ELEMENT. See Abstr. 1562

621.318.1 : 621.374.32

LONG TIME DELAYS FROM A SINGLE MAGNETIC STORAGE CORE. See Abstr. 1567

621.318.1 : 621.374.32 : 539.2 : 538.2

COINCIDENT-CURRENT NONDESTRUCTIVE READOUT FROM THIN MAGNETIC FILMS. See Abstr. 1565

621.318.12 : 621.374.32 : 538

STUDY OF THE RESIDUAL STATES OF FERRITE CORES IN COMPUTER MEMORY OPERATION. See Abstr. 1564

621.318.12 : 621.374.32 : 538

MILLIMICROSECOND SWITCHING PROPERTIES OF FERRITE COMPUTER ELEMENTS. See Abstr. 1563

621.318.12 : 621.374.32 : 538

INHIBITED FLUX — A NEW MODE OF OPERATION OF THE THREE-HOLE MEMORY CORE. See Abstr. 1566

621.318.12

2181 NEW DEVELOPMENTS IN FERRITES. F.Berlinghoff.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 17, 600-5 (Sept. 1, 1959). In German.

Discusses the properties and applications of ferrites. Improvements in the electrical and magnetic properties and new methods of constructing ferrite cores are mentioned. Ferrites for microwaves and magnetic storage devices are described in detail.
R.C.Glass

621.318.12

2182 PERMINVAR FERRITES. M.Kornetzki.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 17, 605-9 (Sept. 1, 1959). In German.

Perminvar ferrites have a constricted magnetization curve and lower hysteresis and after-effect losses than ferrites with a normal magnetization curve. Their properties and characteristics are described.
R.C.Glass

621.318.12

2183 APPLICATIONS OF BARIUM FERRITE MAGNETS. W.Hotop and K.Brinkmann.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 17, 609-15 (Sept. 1, 1959). In German.

Barium ferrite has favourable magnetic properties and does not require costly alloying elements or special heat treatment. Applications of the material, where its large negative temperature-coefficient is not important, are described.
R.C.Glass

621.318.12

2184 FERRITE SPHERE GRINDING TECHNIQUE. J.L.Carter, E.V.Edwards, Jr., I.Reingold, and D.L.Fresh.
Rev. sci. Instrum., Vol. 30, No. 10, 946-7 (Oct., 1959).

Describes a method of accurately grinding small ferrite spheres with a good surface finish. The apparatus used is a Buehler metallurgical grinder which uses an abrasive wheel instead of the original polishing plate assembly. Samples accurately spherical to within 0.001 in. can be produced in a short time.
R.C.Glass

621.318.13

2185 THE PROBLEM OF INHOMOGENEOUS GYROTROPIC MEDIA. V.V.Nikol'skii.
Radiotekhnika i Elektronika, Vol. 3, No. 12, 1518-20 (1958). In Russian.

A microwave model of a medium of the porous ferrite or dielectric type containing scattered ferrite particles is considered. The model adopted is that of a system of spheres uniformly distributed in a filler. The spheres are taken as small with respect to the wavelength in the medium so that the problem can be investigated using the perturbation method. The components of the equivalent magnetic permeability tensor and the equivalent dielectric constant are found. [English summary: PB 141106T-11 obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.].
R.C.Glass

621.318.132 : 621.314.2

2186 COLD-ROLLED TRANSFORMER SHEETS. H.Schlitter and F.Stiblein.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 17, 576-82 (Sept. 1, 1959). In German.

By transformer sheets are included all types of cold-rolled electrical strip which has no highly developed grain orientation or magnetic preference direction. The production of the sheets is described and the differences in the mechanical and magnetic properties of hot- and cold-rolled sheet are discussed. Graphs showing the relation between silicon content and mechanical properties and between sheet thickness and magnetization losses are given.
R.C.Glass

621.318.132 : 621.314.2

2187 ON THE DEPENDENCE OF MAGNETIC PROPERTIES OF ELECTRICAL SHEETS ON DIRECTION, AND THEIR MEASUREMENT. L.Ruess.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 17, 588-93 (Sept. 1, 1959). In German.

The results of measurements of the orientation curves and hysteresis loops for grain-oriented electrical sheet with Goss texture and for single crystals and hot- and cold-rolled transformer and dynamo sheets are described. The development of double grain-oriented sheets with cube texture is discussed. For cold-rolled sheets with marked crystal orientation either Goss or cube texture is obtained. In the case of hot-rolled sheets only those with a slightly developed preference direction in the rolling direction, or with two preference directions below $\pm 40^{\circ}$ to the direction of rolling have been found.
R.C.Glass

621.318.132 : 539.2 : 538.2

2188 AN INVESTIGATION OF THE FREQUENCY DEPENDENCE OF THE PERMEABILITY OF SOME Ni–Fe AND Co–Fe ALLOYS IN THE FREQUENCY RANGE 10^5-10^7 c/s. E.I.Kondorskii and L.G.Smirnova.
Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 237-46 (1958). In Russian.

The materials studied were Mo-permalloy with small anisotropy and magnetostriction, Armco iron which is distinctly anisotropic, and Co–Fe alloys containing 20, 36, 60 and 72% Co and exhibiting considerable magnetistriction. The process of manufacturing the alloys and their cold-rolling and heat-treatment is described in some detail. Chemical composition is tabulated as is also the electrical and mechanical properties. For this purpose samples were prepared in the form of tape-wound toroids. The measurements were carried out on a Maxwell bridge and are presented as permeability and resistivity v. frequency for each material. In some cases it is possible to point out the indirect confirmation of theory.
S.C.Dunn

621.318.2 : 538.1

2189 SOME ASPECTS OF THE DESIGN OF LARGE PERMANENT MAGNETS. J.E.Cousins and W.F.Nash.
Brit. J. appl. Phys., Vol. 10, No. 11, 471-5 (Nov., 1959).

The design and construction of a large permanent magnet for

use in cosmic ray studies is considered. It is shown that there is an optimum distribution of the magnetic material in order to obtain either a maximum field, H, or a maximum line integral, $\int_{-\infty}^{+\infty} H dy$, for a given pole face area and gap size. It has been shown that a good value of the leakage factor for use in the design calculations for magnets with rectangular pole faces can be predicted theoretically. Detailed comparison between results predicted by this theory and those obtained in practice with the present magnet and other large permanent magnets suggest that these calculations can be usefully applied to magnets with pole faces of any shape. These comparisons also show, in agreement with Andrew and Rushworth (1955), that demagnetization curves for small specimens of magnetic material are not reliable where large blocks are considered.

621.318.2

2190 FUTURE PROSPECTS FOR THE DEVELOPMENT OF MAGNETIC MATERIALS. F.Pawlek.
Elektrotech. Z. (E.T.Z.) A, Vol. 80, No. 17, 561-5 (Sept. 1, 1959). In German.

Discusses the theoretical possibilities in the development of permanent magnetic materials, of Alnico alloys, powder magnets and oxide magnets. No limiting figures are yet available for ferrites. Some magnetic oxide compounds which are now available are described. R.C.Glass

621.318.23 : 621.395.623.74

2191 LOUDSPEAKER MAGNET DESIGN. WITH SPECIAL REFERENCE TO CAPPED CYLINDRICAL SLUGS OF ALCOMAX III. A.E.Falkus.
Wireless Wld, Vol. 66, No. 1, 41-4 (Jan., 1960).

621.318.3

2192 INDUCTANCE OF A.C. MAGNETS FROM SIMPLE MODELS. J.F.H.Douglas and R.J.Voith.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 562-8 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

The inductance of an a.c. magnet may be calculated once the equivalent permeance of the magnetic field is known. To determine this permeance the fields are split into components which may be simulated by simple models. These individual permeances are superposed to give the final result. Since there are, in general, Laplacian and non-Laplacian components, two kinds of model are used. A component field which has a potential function at all parts may be simulated by an electroconducting analogue model, while one which has no potential function must be simulated by a model having a coil and iron parts. A simple a.c. magnet is considered and a description is given of the models used. Fair agreement is obtained between the predicted and the measured performance of the magnet. H.L.Nattrass

INDUCTORS . REACTORS RELAYS

621.318.424 : 621.372.512.24

2193 NON-LINEAR OSCILLATIONS OF A.C. CIRCUITS CONTAINING IRON [-CORED MUTUAL INDUCTANCES]. S.Kubík.
Acta tech. (Prague), Vol. 4, No. 4, 283-322 (1959). In German.

The phase-plane method is extended to include the treatment of non-homogeneous, non-linear second order differential equations. The forcing function, a harmonic, single-frequency voltage, is applied to the following circuits: a saturated perfectly coupled transformer with a capacitive load; a transformer as before with a linear RLC series circuit between the supply and the transformer, the secondary open-circuited; non-ideal transformer, saturated, with a capacitive load. The calculated results are compared with oscillograms. The mathematical basis of the method is explained in an appendix. E.Erdelyi

621.318.424 : 538.3

2194 CORRECTION FOR SIZE OF CROSS-SECTION OF THE SECONDARY WINDINGS OF MUTUAL INDUCTANCE STANDARDS OF THE CAMPBELL TYPE. P.Vigoureux.
Brit. J. appl. Phys., Vol. 10, No. 11, 481-3 (Nov., 1959).

It is shown that the mutual inductance of standards of the Campbell type can be obtained with negligible error by replacing each turn of the secondary winding by a circle at the centre of the cross-section of the wire. The total inductance is the sum of the inductances of individual circles; this sum is expressed by a formula which is shown to agree with Searle's formula provided the length and breadth of winding used in the latter are based on the mean spacing and the mean number of wires in the rows and layers.

621.318.435.3 : 538.56

2195 THE BISTABLE BEHAVIOUR OF THE MAGNETIC TRANSDUCTOR. E.H.Frei, S.Shtrikman and D.Treves.
Brit. J. appl. Phys., Vol. 9, No. 10, 394-5 (Oct., 1958).

It is already well-known that the second harmonic magnetic transductor has instability regions. It has been found experimentally that in each region two modes of output current exist, differing only by the phase which these currents have with respect to the exciting voltage. Under suitable parameters and excitation conditions, the transductor will jump from one mode of operation to the other, whenever the exciting current is modulated with a negative pulse. It therefore operates like a bistable element.

621.318.435.3

2196 SELF-SUSTAINED MODULATIONS IN TRANSDUCTOR CIRCUITS WITH SERIES CAPACITORS. F.Dahlgren and R.Ładziński.
K. Tekn. Högsk Handl., No. 148, 62 pp. (1959).

Transductors with series capacitors in the a.c. circuits create, under certain conditions, amplitude-modulation of all electrical quantities in the circuits involved. A contribution to the understanding of this phenomenon is presented, as well as confirming experimental results.

621.318.435.3

2197 OBSERVATION OF TRANSIENTS IN THE SERIES-CONNECTED SATURABLE REACTOR WITH HIGH-IMPEDANCE CONTROL SOURCE. H.L.Goldstein.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 521-6 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

A saturable reactor with high-impedance control source, operating in its proportional mode where gate ampere-turns equal control ampere-turns, can be thrown out of this mode through a transient caused by a sudden change in operating conditions. In the experiments described here, transients are introduced by short-circuiting the load resistance or removing a short-circuit from it. The deviation from proportional behaviour which results in a rounding of the normally rectangular gate-current wave or a current and voltage spike, occurs only during one cycle after start of the transient. After that the circuit returns to its proportional mode. The phase of the gate current after a transient in general assumes its corresponding new value only gradually with the amount of damping (equals rate of return to steady state) determined by the magnitude of the load resistance in the new condition. By suitably choosing the switching instant, the circuit can be moved immediately from one steady state to another without any transient. Experimental and theoretical results agree within the accuracy of measurement. S.C.Dunn

ELECTROSTATICS . CAPACITORS

621.319.2

2198 ELECTRETS WITH CERAMIC DIELECTRICS. M.Turek.
Direct Curr., Vol. 4, No. 7, 204-11 (Dec., 1959).
For abstr. see Abstr. 2830 (1959).

621.319.2

2199 RESIN ELECTRETS. J.Euler.
Elektrotech. Z. (E.T.Z.) B, Vol. 11, No. 9, 359-64 (Sept. 21, 1959). In German.

A review of the phenomena characteristic of electrets and an account of the theories advanced to explain the effects. Some measurements of the author's are included, and the paper ends with a review of practical applications. K.W.Plessner

621.319.3

2200 RECENT DEVELOPMENTS AND FUTURE TRENDS IN ELECTROSTATIC GENERATION. N.J.Felici.
Direct Curr., Vol, 4, No. 7, 192-201 (Dec., 1959).

621.319.45 : 539.23

2201 ELECTRON CONDUCTIVITY AND GRAIN STRUCTURE OF ANODICALLY FORMED ALUMINIUM OXIDE FILMS. S.Raether.
Z. angew. Phys., Vol. 11, No. 12, 456-60 (Dec., 1959). In German.

The films considered are of the insulating type formed in boric acid. A comparison between weight increase of the aluminium foil and charge transported during forming shows that for final voltages above 200, there is an appreciable contribution from an electronic current through the oxide. A change in film structure at the same voltage is deduced from measurements of mechanical stress in the film and from the effect on leakage current of dissolving some of the oxide in chrome-phosphoric acid. K.W.Plessner

621.319.53

2202 GENERATION OF IMPULSE VOLTAGES BY MEANS OF HIGHLY DAMPED OSCILLATORY CIRCUITS.
W.Baumann.
Arch. tech. Messen, No. 283, (Ref. Z 44-5), 173-6 (Aug., 1959). In German.

A mathematical and experimental investigation is given of an impulse discharge circuit comprising capacitance, inductance and resistance. The efficiency of the circuit is examined and it is found that it is particularly suitable for tests involving a large capacitance at comparatively low discharge voltage where the front and tail durations of the test voltage required are of the same order of magnitude. R.H.Golde

621.319.74

2203 THE QUESTION OF NEUTRALIZING STATIC ELECTRIC CHARGE BY RADIOACTIVE RADIATION.
N.G.Drozdov and V.N.Egorov.
Elektrichestvo, 1959, No. 10, 63-7 (Oct.). In Russian.

The paper is concerned with the choice of suitable radioactive sources, e.g., radium, polonium 210 or plutonium 239, for neutralizing electric charge occurring in industrial processes, by ionizing the surrounding air. Practical data are given for calculating the activity and ionizing efficiency of commonly available alpha and beta sources. Consideration is given to safety precautions to be observed on industrial sites where potentially dangerous materials, e.g., strontium 90, are used in production schedules. T.Mulvey

LAMPS . ILLUMINATION

621.327 : 535.8

2204 SIMPLE LIGHT SOURCE OF ABOUT 10 mμsec DURATION. G.Porter and E.R.Wooding.
J. sci. Instrum., Vol. 36, No. 3, 147 (March, 1959).

A coaxial design enables sparks of 11 to 13 mμs duration to be obtained. The peak intensity is of the order of 1 W and the spectral range is greater than 1900 to 6000 A. E.R.Wooding

621.327.534.15

2205 APPLICATION OF GASEOUS RADIOACTIVE ISOTOPES IN ILLUMINATION ENGINEERING. G.Siljeholm.
Ljuskultur, Vol. 31, No. 4, 189-91 (Oct.-Dec., 1959). In Swedish.

When a voltage is applied to glow tubes, glow relays or igniters which have been out of service for long periods, a time delay frequently occurs before restriking. This delay can be reduced by adding a small quantity of tritium or krypton 85, which are sources of β-particles, to the normal filling gases. Experimental fluorescent tubes on the same principles are described. Using tritium additive neither hot cathode nor high voltages are required. A Swedish design described converts an input power of 0.15 mW into a light flux of 5 mL using a green fluorescing Mn-activated zinc sulphide powder. G.N.J.Beck

628.971

2206 CALCULATION OF THE AVERAGE ILLUMINATION IN STREET LIGHTING INSTALLATIONS. K.F.Stubert.
Lichttechnik, Vol. 12, No. 2, 69-72 (Feb., 1960).

When a fitting is suspended over a long and straight roadway, the total flux reaching the road surface can be found from the ratio of road width to mounting height if the light distribution from the fitting is known in the form of polar curve in a number of planes passing through the centre of the fitting and parallel to the axis of the roadway. For any particular fitting a curve, called B/H curve, can be constructed to show the total flux reaching the road surface for any value of the ratio of breadth to mounting height. The application to finding the average illumination with a particular system of units is explained by means of an example. J.W.T.Walsh

628.972

2207 INTEGRATED LIGHTING-AIR CONDITIONING SYSTEMS. W.S.Fisher and J.E.Flynn.
Illum. Engng, Vol. 54, No. 10, 615-24 (Oct., 1959).

Heat from the lamps in a lighting system giving an illumination of 100 lm/ft^2 or over cannot be neglected. It is shown how the heat can be controlled and made use of economically by designing the lighting with the air-conditioning system as an integrated whole. When the occupied room requires cooling, the heat from the lamps and fittings is exhausted to the outside; when the occupied room requires heat, the exhaust air is recirculated with warm air from the heating unit, the load on which is thereby reduced. J.W.T.Walsh

628.972

2208 PERFORMANCE CHARACTERISTICS OF COMBINATION AIR-DIFFUSING TROFFERS.
M.L.Quin and W.W.Kennedy.
Illum. Engng, Vol. 54, No. 11, 695-704 (Nov., 1959).

Describes fluorescent lamp fittings for use in systems where the lighting and air-conditioning are treated as inter-related (see preceding Abstr.). Actual installations were tested and measurements were made of the temperature rise of fittings and ballasts, of the noise produced and of the effect on lamp performance. Additional information is given in the discussion, especially by L.A.Archer. J.W.T.Walsh

628.972

2209 THE DISTRIBUTION OF INTERREFLECTED LIGHT IN RECTANGULAR ROOMS. J.M.Waldram.
Light and Ltg, Vol. 53, No. 2, 42-4 (Feb., 1960).

Explores the distribution of light reflected from the walls, ceiling and working plane on to the other surfaces of a rectangular room, showing how the contributions of the various surfaces change over the room, and the relevance of the mean illumination as found by Phillips' P_k factors.

ELECTROCHEMISTRY

621.352

2210 ELECTROCHEMICAL AUXILIARY POWER SOURCES FOR MISSILES AND SPACE FLIGHT. M.Eisenberg.
Elect. Engng, Vol. 79, No. 1, 58-63 (Jan., 1960).

Reviews the chief sources of power derived from primary batteries, fuel cells, and secondary batteries and their suitability, output and efficiency as compact power units. For missiles the high rate of discharge, and total life of 4 to 7 minutes required, favours the primary types of energy source and their advantages and shortcomings are discussed. Of the fuel cells the high power density and conversion factor of the Bacon cell is an outstanding feature and responsible for the strong interest in developing fuel cells on the part of satellite designers. The fundamental principles of electrochemical fuel cells are outlined and some suitable applications listed, including the possibility of combining them with nuclear energy sources to avoid the losses inherent in the heat-engine cycle. A.P.Paton

621.355.15

2211 IMPROVEMENT OF CAR STORAGE BATTERIES BY USING SILICA GEL. L.Pesty.
Elektrotechnika, Vol. 52, No. 8-9, 383-6 (Aug.-Sept., 1959). In Hungarian.

The effects of adding silica gel to both the positive and negative plate material of lead acid batteries are described and considerable improvement is claimed in the performance during starting conditions. The storage capacity and the useful life of such batteries increases and the manufacturing processes become easier. L.Csuros

621.355.9

2212 BATTERIES WITH SOLID ION-EXCHANGE MEMBRANE ELECTROLYTES. II. LOW-TEMPERATURE HYDROGEN–OXYGEN FUEL CELLS. W.T.Grubb and L.W.Niedrach.
J. Electrochem. Soc., Vol. 107, No. 2, 131-5 (Feb., 1960).

Hydrogen–oxygen fuel cells employing a commercial ion-exchange membrane as the electrolyte are described. Some performance data on this type of cell operating at room temperature with a cation membrane in the hydrogen form and with hydrogen and oxygen at 1 atm are presented. The open circuit e.m.f. is about 0.3 V below the value of 1.23 expected for a reversible cell. This deficiency is found to be caused by the oxygen electrode which does not achieve the reversible half-cell potential. Equilibrium of the membrane electrolyte with sulphuric acid prior to cell assembly results in improved polarization characteristics. Favourable features of these cells include their simple construction and their small unit thickness. In addition, the presence of as much as 6% CO_2 in the hydrogen feed gas is found to have little effect upon performance. Since the electrolyte is a cross-linked, water-saturated polymer, the electrolyte is locked into the structure and cannot be leached from the cell when it is operated within the stability limits of the polymer. No dilution occurs from the water formed at the oxygen electrode during cell operation because it is rejected from the saturated electrolyte.

621.357.5 : 539.2 : 535

2213 THE RELATIONSHIP BETWEEN BRIGHTNESS AND STRUCTURE IN ELECTROPLATED NICKEL.

R.Weil and R.Paquin.

J. Electrochem. Soc., Vol. 107, No. 2, 87-91 (Feb., 1960).

Nickel deposits of various brightnesses were plated from Watts baths containing several different addition agents. The as-plated surfaces of the deposits were examined by electron microscopy. All bright deposits had a very fine-grained structure. However, some fine-grained deposits showed surface crevices and were therefore not bright. A linear relationship between the fraction of the surface area having a roughness less than 0.15 μ and the logarithm of light reflected as measured with a photocell was found. There is no direct relationship between the degree of preferred orientation and brightness, but the fibre axis is related to the type of structure observed, i.e. platelet, equiaxed crystallite, or spiral-type, and the addition agents in the plating bath.

621.357.5 : 539.23

2214 THE ADHESION OF ELECTRODEPOSITED NICKEL TO CHROMIUM AT ELEVATED TEMPERATURES.

W.E.Reid, Jr and F.Ogburn.

J.Electrochem. Soc., Vol. 107, No. 2, 91-3 (Feb., 1960).

The use of a composite coating of electrodeposited nickel and chromium to protect molybdenum from oxidation at elevated temperatures has certain practical limitations. Examination of the composite coating showed that the problems of blister formation, weakening of the bond between nickel and chromium, and edge separation were interrelated. Blister formation was eliminated and edge separation reduced slightly by an improved treatment of the chromium surface prior to nickel plating. The weakening of the bond between nickel and chromium appears to be inherent in the coating system.

621.357.7

2215 CHROMIUM PLATING WITH A SELF-REGULATING ELECTROLYTE. R.Justh.

Tekn. T., Vol. 90, No. 2, 29-31 (Jan. 8, 1960). In Swedish.

A newly developed self-regulating bath based on chromic acid is described. A mixture of strontium sulphate and potassium hexafluorosilicate is used, instead of sulphuric acid, as a catalyst and to produce a self-regulating electrolyte. Tests show that as regards quality of the deposit, current requirements, potentials and stability, the self-regulating bath gives superior results. It is much less sensitive to temperature charges than is the bath using sulphuric acid and gives a smooth chromium deposit over a wide current-density range. The rate of deposition is shown as a function of temperature for values of current density between 20 and 100 A/dm^2. G.N.J.Beck

621.359

2216 ELECTRICAL ASH FILTERS IN THE THERMAL POWER STATION NHKG IN OSTRAVA-KUNČICE.

B.Klobouk.

Energetika (Prague), Vol. 9, No. 10, 497-502 (1959). In Czech.

The 42 kW electrostatic ash-precipitator was not functioning as delivered and the necessary design changes and rectifier-unit increases are described. The expected performance of the filter was calculated according to the usual formulae and an ash-separation efficiency of 90 ± 2% was estimated for a flue-gas flow rate of 65 m^3/sec. By determining the "ash balance", i.e. by weighing coal input and slag and ash contents in the boiler furnaces and in the filter a separation efficiency of 92.8 ± 2.7% was found for a flue-gas flow rate of 80 m^3/sec. The current under these conditions was 383 mA and flue gases leaving the filter contained 0.93 g/m^3 of fine ash. N.Klein

ELECTRIC HEATING

621.362

2217 THERMOELECTRIC PHENOMENA AND THEIR APPLICATION. Z.Poslt.

Slaboproudy Obzor, Vol. 20, No. 12, 754-9 (1959). In Czech.

Reviews the principal thermoelectric phenomena and analyses some of their applications. Formulae describing relevant characteristics of various devices are derived. The Seebeck effect can be utilized in constructing a thermoelectric generator. Efficiencies up to 5% can now be obtained by employing suitable semiconductor materials (intermetallic compounds). The Peltier effect can be used in the construction of thermoelectric cooling devices (refrigerators) or heaters. When employing semiconductors, efficiency of the cooling devices can be made comparable with that of absorption type refrigerators. A semiconductor diaphram can be used as a sound generator. The thermionic emission effect can be utilized to convert heat directly into electric energy; the conversion efficiency can in practice be as high as 10%. R.S.Sidorowicz

621.362 : 539.2 : 537.32

2218 THE THERMOELECTRIC FIGURE OF MERIT AND ITS RELATION TO THERMOELECTRIC GENERATORS.

R.P.Chasmar and R.Stratton.

J. Electronics and Control, Vol. 7, No. 1, 52-72 (July, 1959).

The expression for the figure of merit of a semiconductor of given carrier mobility and lattice thermal conductivity expressed in terms of generalized Fermi–Dirac functions has been numerically evaluated for various scattering indices. The results are presented graphically enabling the maximum figure of merit to be found. High-temperature limitations due to minority carrier production are considered in relation to the energy gap of the semiconductor. The results are discussed in connection with bismuth telluride and other sulphides, selenides and tellurides of the heavy metals.

621.362 : 539.2 : 537.32

2219 THE FIGURE OF MERIT OF A THERMOELECTRIC GENERATOR. R.Stratton.

J. Electronics and Control, Vol. 7, No. 1, 73-6 (July, 1959).

Optimum conditions are deduced for a thermoelectric generator or refrigerator with n- and p-type semiconducting branches which have different physical parameters. The results are related in a simple manner to the previously calculated optimum conditions for the individual figure of merit of a single substance.

621.363

2220 SOLAR-POWERED THERMOELECTRIC GENERATOR DESIGN CONSIDERATIONS. N.F.Schuh and R.J.Tallent.

Trans Amer. Inst. Elect. Engrs II, Vol. 78, 345-52 (1959) = Applic. and Industr., No. 45 (Nov., 1959).

Presents, in a brief manner, some of the principles and problems which may be expected in applying solar energy to a thermoelectric generator serving a space vehicle and also describes a small solar-powered thermoelectric generator which was constructed to study these problems.

621.365.3

2221 SOME RESULTS WITH ELECTRIC HEATING. K.Frøslev and G.Lund-Jensen.

Elektroteknikeren, Vol. 56, No. 2, 27-29 (Jan. 22, 1960). In Danish.

A house belonging to the Vestkraft supply authority was completely fitted with electric radiant heating (61 radiators each of 0.6 kW) for experimental purposes. Physical dimensions and thermal conductivity of all heat-losing surfaces were known so that heat losses could be calculated according to established Danish rules. Annual consumption calculated according to the rules was double that measured and a 50% difference was noted for a monthly period in winter. The contribution from the sun partly accounted for the annual discrepancy, while an overestimation of ventilation losses explained that found during the winter months. The method of loss calculation is explained in detail. Total annual costs of insulation

and heating are shown as a function of the degree of insulation for both electric and oil heating, the latter being appreciably dearer with present Danish tariffs. G.N.J.Beck

621.365.39 : 621.315.59

2222 A SILICON-INGOT-GROWING FURNACE USING ELECTRON-BOMBARDMENT HEATING. D.B.Gasson.
Proc. Instn Elect. Engrs, Paper 3020 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 854-7, 883-4 (1959).

A new type of furnace for preparing single-crystal ingots of silicon by the Czochralski technique is described. The ingot can be conveniently pulled from a melt resting on the parent solid material which in turn rests on a cooled metal hearth. The charge is heated by four focused and deflected electron beams, and a feature of the gun design is a movable cathode for controlling the magnitude of the electron current. Infrared absorption measurements on ingots prepared by this technique indicate that the bulk oxygen content is much less than in ingots prepared from crucible-held melts.

621.365.41 : 545

2223 LINEAR VOLTAGE TEMPERATURE FURNACE FOR THERMAL ANALYSIS. A.J.Martin and K.L.Edwards.
J. sci. Instrum., Vol. 36, No. 4, 170-2 (April, 1959).

A furnace is described which may be operated in a vacuum or an inert atmosphere, and which was developed for thermal analysis studies of beryllium and its alloys. Extremely rapid heating and cooling rates may be employed if required, or, with slow heating and cooling rates, a linear variation in voltage with time will produce a correspondingly near-linear variation in temperature. This is of great value in thermal analysis work, and is very much cheaper than the electronic controllers or mechanical cam devices that are usually necessary.

621.365.5

2224 THERMAL PROCESSES IN TUBULAR INDUCTION HEATERS. D.D.Dobryakov.
Latv. PSR Zinat. Akad. Vestis, No. 5 (142), 77-80 (1959). In Russian.

Develops equations which demonstrate the relations between the electric, thermal and geometrical parameters of the heating element. F.Lachman

621.365.9

2225 HEAT-RECOVERY PLANT FOR PAPER-MAKING MACHINES. W.Steiner.
Schweiz. tech. Z. (S.T.Z.), Vol. 56, No. 47, 937-44 (Nov. 19, 1959). In German.

A method is described in detail by which the heat used for drying is recovered in order to save fuel. The drying section is enclosed by a hood and the moist air is conveyed through heat-exchangers, one of which heats fresh air which is used for various purposes and the second heats fresh water for use in the paper-making section. A numerical example of the saving is included. R.G.Jakeman

ELECTRIC WAVES AND OSCILLATIONS

LINES . NETWORKS . FILTERS

621.372

2226 A DEVICE FOR THE EXPERIMENTAL STUDY OF THE DIFFRACTION OF CENTIMETRIC WAVES. J.Mével.
J. Phys. Radium, Vol. 18, Suppl. No. 3, 45A-53A (March, 1957). In French.

This device operates at 1.25 cm and enables the phase and intensity at any point of the electromagnetic field to be determined. Two versions are presented: one for studying scattering in the vicinity of the axis, the other for scattering at large angles. The characteristics of the apparatus and some experimental results are described.

621.372

2227 TRANSVERSE ELECTROMAGNETIC FIELDS (TYPE TEM). K.Bochenek.
Bull. Acad. Polon. Sci. Ser. Sci. tech., Vol. 7, No. 11, 655-7 (1959). In French.

A method is proposed for deriving the general integral of the equations to TEM fields. The method is first to eliminate E from the equations and to consider the behaviour of the field equations in a sub-domain which is a cylinder of revolution whose generatrix is parallel to one of the axis of coordinates. The general integral is then given in the form of the real and imaginary parts of a function and its analytic continuation. S.C.Dunn

621.372

2228 THE ASYMPTOTIC SOLUTION OF THE PROBLEM OF DIFFRACTION OF PLANE ELECTROMAGNETIC WAVES BY AN IDEALLY CONDUCTING SPHERE. A.A.Fedorov.
Radiotekhnika i Elektronika, Vol. 3, No. 12, 1451-62 (1958). In Russian.

The exact solution of the problem of diffraction by an ideally conducting sphere is in the form of series which converge very slowly for large values of ka (where k is the wave number and a is the radius of the sphere) and is thus of little practical value. The asymptotic solution gives formulae which can be used in practice. Results of the asymptotic solution are given for ka = 5 and ka = 10. Comparison with the rigorous solution shows that for ka = 5 satisfactory agreement is obtained which improves as ka increases. [English summary: PB 141106T-11, obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.]. R.C.Glass

621.372.2

2229 GRAPHICAL SOLUTION OF PROBLEMS WITH LOSSY TRANSMISSION LINES. K.E.Müller.
Hochfrequenztech. u. ElektAkust., Vol. 68, No. 2, 61-4 (July, 1959). In German.

The Smith chart technique is applied to the solution of problems involving lossy transmission lines. The procedure is illustrated by numerical examples. A.E.Karbowiak

621.372

2230 THE DIFFRACTION OF PLANE WAVES BY A WIRE GRID SITUATED INSIDE A DIELECTRIC SLAB.
V.G.Yampol'skii.
Radiotekhnika i Elektronika, Vol. 3, No. 12, 1516-18 (1958). In Russian.

The rigorous solution of the problem of the diffraction of plane waves incident normally on a wire grid composed of thin conductors in a plane slab of dielectric is derived, no restriction being placed on conductor separation. The case where the grid is half-way between the faces of the dielectric is considered and the transmission factor of the system is evaluated. [English summary: PB141106T-11, obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.]. R.C.Glass

621.372.2

2231 REFLECTION COEFFICIENT CURVES OF COMPENSATED DISCONTINUITIES ON COAXIAL LINES AND THE DETERMINATION OF THE OPTIMUM DIMENSIONS.
A.Kraus.
J. Brit. Instn Radio Engrs, Vol. 20, No. 2, 137-52 (Feb., 1960).

Discontinuities on coaxial lines are caused either by irregular cross-section or variation of dielectric constant. Equivalent circuits of different types of discontinuity are given. The node-shift technique employing an adjustable short circuit for determining the reflection coefficient is described. Test results are discussed at length and a series of curves for various configurations given.

621.372.4

2232 STEADY-STATE TRANSMISSION THROUGH A NETWORK CONTAINING A SINGLE TIME-VARYING ELEMENT. C.A.Desoer.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 3, 244-52 (Sept., 1959).

Presents a method of steady-state analysis of a linear network, of arbitrary degree of complexity, containing a single periodically varying element. The proposed method makes full use of circuit theoretical ideas, such as impedance matching and tearing apart, and of iteration techniques which are particularly suitable for

automatic computation. The proposed method has the additional feature of leading to the amplitude and phase of all sidebands and of giving a bound on the error if the iterations are stopped at any particular point. More precisely, it is shown that, provided the impedance seen by the time-varying element becomes capacitive at very high frequencies, the complete solution can be found within an arbitrary amount of accuracy.

621.372.413

2233 RESONATORS WITH TENSOR MEDIA. A.G.Gurevich.
Radiotekhnika i Elektronika, Vol. 3, No. 12, 1475-84 (1958). In Russian.

Some aspects of the general theory of cavity resonators containing tensor media are discussed. The method of eigenfunctions of a cavity resonator, prevoously used for scalar media, is applied to the problem of forced oscillations in tensor media. The eigenfunctions derived are found to be complex i.e. the field does not produce standing waves, and in the case of waveguide resonators do not correspond to the superposition of two oppositely travelling waves. [English summary: PB 141106T-11, obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.]. R.C.Glass

621.372.413 : 621.387 : 537.52

THE EFFECT OF FIELD CONFIGURATION ON GAS DISCHARGE BREAKDOWN IN MICROWAVE CAVITIES AT LOW PRESSURE. See Abstr. 1709

621.372.5 : 621.395.62

2234 THE QUADRIPOLE EQUIVALENT CIRCUITS OF ELECTROMECHANICAL TRANSDUCERS. PART II. A.Lenk.
Acustica, Vol. 6, No. 3, 303-16 (1956). In German.

For Pt I, see Abstr.2067(1955). For piezoelectric and magnetostrictive transducers, different equivalent circuits are proposed (depending on the static fundamental equations) and their interrelation set out. Complete groups of transducers are systematically correlated, with regard to their physical properties and equivalent circuits.

621.372.5

2235 ON A PROBLEM OF NETWORK TOPOLOGY. T.Fujisawa.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 3, 261-6 (Sept., 1959).

In mesh-basis analysis of networks with mutual and active elements, it is necessary to list all possible trees of cotrees and signs of cotree determinants. A computational method for obtaining them is given. Computations are based on fundamental circuit matrices. A transformation from one tree to another may be performed by elementary transformations on circuit matrices. By this method, all the trees and fundamental circuit matrices may be determined. Signs of cotree determinants and their minor determinants of a fundamental circuit matrix may also be easily determined.

621.372.5

2236 THE PATH MATRIX AND ITS REALIZABILITY. O.Wing and W.H.Kim.
I.R E. Trans Circuit Theory, Vol. CT-6, No 3, 267-72 (Sept., 1959).

Presents in one listing those properties of the path matrix of a graph which are fundamental and interesting in nature. Included are (1) a relation between the path matrix and the incidence matrix; (2) the rank of the path matrix; (3) relations between paths and cut sets; and (4) relations between paths and circuits (Ashenhurst's lemmas). A number of necessary conditions for the realizability of a matrix as a path matrix of a graph is also included.

621.372.5

2237 A NOTE ON ZEROS OF REFLECTION AND TRANSMISSION IN A CASCADE OF LOSSLESS TWO-TERMINAL-PAIR NETWORKS. D.C.Fielder.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 3, 282-7 (Sept., 1959).

Theorems and proofs pertaining to interrelations among the reflection and transmission coefficients of complete cascade and the two-terminal-pair networks are presented. A discussion of degenerate transmission zeros is then presented. The effects on transmission coefficients of adding various right-half s-plane zeros of reflection are investigated. Reflection zeros are added so that the real frequency magnitude of a reflection coefficient is invariant under the addition of reflection zeros.

621.372.5

2238 ENVELOPE AND ANGLE RESPONSE OF ASYMMETRICAL NARROW-BAND NETWORKS. J.J.Hupert.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 3, 292-5 (Sept., 1959).

Outlines a general approach to the evaluation of envelope and angle response of narrow-band networks, including asymmetrical networks. From a known constellation of poles and zeros of a network in the s-plane, approximate linearized transfer functions are developed which relate envelope and angle response of the network to the amplitude modulation of the forcing function for small signal conditions (shallow modulation). The transfer functions are expressed in terms of two auxiliary constellations in the p-plane, where p is equivalent to the complex frequency of modulation.

621.372.5

2239 THE DEFINITION OF NOISE FACTOR WHEN APPLIED TO SYSTEMS CONTAINING NEGATIVE RESISTANCE ELEMENTS. B.L.Humphreys.
J. Electronics and Control, Vol. 7, No. 1, 77-81 (July, 1959).

621.372.5

2240 SOME FURTHER APPLICATIONS OF THE MATRIX INTERPRETATION OF THE NODE-VOLTAGE METHOD. J.Cajka.
Slaboproudy Obzor, Vol. 20, No. 12, 768-74 (1959). In Czech.

The work employs the results of the author's earlier paper (see Abstr. 1559 of 1958). The node-voltage method is used to evaluate the elements of an active three-terminal device (transistor or valve) having series impedances connected to its terminals. Further, formulae for determining the parameters of a constant-current (or voltage) generator, when it is transferred from one pair of terminals to another pair, are derived. A general chain network consisting of n different quadripoles is considered and its generalized transfer function is evaluated. It is shown that when the elements of the network increase (or decrease) progressively, or are identical, its parameters can be described in terms of polynomials. The polynomials are functions of the network determinant of a single quadripole. R.S.Sidorowics

621.372.512.23

2241 RC CONSTANT-ARGUMENT DRIVING-POINT ADMITTANCES. R.Morrison.
I.R.E. Trans Circuit Theory, Vol. CT-6, No. 3, 310-17 (Sept., 1959).

Deals with a class of RC driving-point immittances characterized by nearly constant argument over an extended frequency range. These arguments may have an average value between the limits zero and $\pi/2$ radians. Networks having near constant argument are of importance in shaping the phase character of the forward gain in feedback systems. These networks have arguments that oscillate about a mean value and the nature of this oscillation is discussed. The poles of admittance are geometrically spaced along the negative-real frequency axis, and consequently the elements of the network can be thought of as "spaced". The immittance functions and argument oscillations for the $22\frac{1}{2}°$, $45°$ and $67\frac{1}{2}°$ cases as a function of spacing are fully discussed. An amplification to a feedback amplifier design is given.

621.372.54

2242 A SIMPLE WAVE FILTER. D.G.Wyatt.
Electronic Engng, Vol. 32, 155-7 (March, 1960).

It is possible to obtain a useful filter of the high-pass or low-pass type by connecting a parallel-T circuit in series with a suitable LC circuit. Only one inductance is required, and this is especially useful at low cut-off frequencies. The arrangement compares favourably both with filters of the conventional type, and with those derived from negative-feedback amplifiers, on grounds of simplicity, stability, and bulk.

621.372.54

2243 AN ANALOGUE APPARATUS FOR FILTER DEVELOPMENT TASKS. W.Poschenrieder and H.Sontheim.
Frequenz, Vol. 13, No. 12, 379-85 (Dec., 1959). In German.

The apparatus comprises a model low-pass filter, a multiple-frequency source and a level-measuring oscilloscope. Low-pass filters with up to six rejector circuits may be set up by means of links and the shunt capacitances and rejector impedances may be varied in steps of 1%. An iterative procedure for adjusting matching and ripple in the pass band is described. Other applications discussed are investigation of the effects of changes in component

values, the correction of attenuation characteristics by insertion of resistance, and the design of pulse filters with given rise and fall time and overshoot requirements. W.G.Stripp

621.372.54

2244 THE PROBLEM OF PHASE EQUALIZATION. G.Szentirmai.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 3, 272-7 (Sept., 1959).

The equalization of the insertion-phase v. frequency characteristics of low-pass filters and low-pass like networks is considered. A method is described for maximally flat equalization by minimum-pass or all-pass equalizers. The method can be readily extended to a nearly equal-ripple approximation by using Darlington's method of Chebyshev polynomial series.

621.372.54

2245 OPTIMUM FILTERS OF EVEN ORDERS WITH MONOTONIC RESPONSE. M.Fukada.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 3, 277-82 (Sept., 1959).

Recently, Papoulis has developed a new class of filter (see Abstr. 3020 of 1958) which has the maximum cutoff rate under the condition of a monotonically decreasing response. These new filters are based on the optimum monotonically increasing polynomials of odd degrees. Optimum polynomials of even degrees are presented in general forms, from which optimum filters with monotonic response are derived. Characteristics of these filters are illustrated by several examples which include frequency-response, pole locations and the ladder realizations.

621.372.542.2

2246 LOW-PASS FILTER FOR SUBAUDIO FREQUENCIES. R.C.Onstad.

Electronics, Vol. 33, No. 3, 88-90 (Jan. 15, 1960).

The necessity for rejection of unwanted higher frequencies fed into a telemetry multiplexer has led to a design of a suitable l.p. filter. Selectivity requirements coupled to those for flatness in the pass-band, low d.c. insertion loss and output impedance determine the design parameters. Since inductances and thermionic tubes are prohibitive in volume and weight and a passive RC filter would not fulfil the above requirements, transistors and solid tantalum capacitors are used. The design developed is essentially a cascaded RC filter with feedback. T.Horrocks

621.372.54

2247 IMPULSING OF LINEAR NETWORKS IN INTEGRATED DATA SYSTEMS. G.K.McAuliffe.

I.R.E. Trans Commun. Syst., Vol. CS-7, No. 3, 189-94 (Sept., 1959).

Waveforms useful in data transmission may be obtained by impulsing suitable linear networks, and these same networks may be used, in certain cases, as receiving matched filters. A filter-design for certain low-pass waveforms is described, together with a procedure for realizing band-pass analogues of these low-pass waveforms. The latter avoid the use of modulators. Practical results are described.

621.372.542.2

2248 ANALYSIS OF THE THIRD-ORDER BESSEL FILTER FOR THE DETECTION OF PULSED SIGNALS IN NOISE. H.S.Heaps and P.G.Kennedy.

Trans Engng Inst. Canada, Vol. 3, No. 3, 85-8 (Nov., 1959).

Analyses the effect of a third-order low-pass Bessel filter upon a rectangular signal received upon a background of white noise. The ratio of the signal-to-noise energy contained in a sample of the output is found as a function of the filter parameter and the ratio of output sample length to input pulse length. It is found that with proper choice of the filter parameter the Bessel filter may be made very efficient in maximizing signal-to-noise energy. Similar results have previously been obtained for the Butterworth and Chebyshev filters.

621.372.56

2249 WIDE-BAND ABSORBER FOR ELECTROMAGNETIC WAVES. J.Deutsch and P.Thust.

Z. angew. Phys., Vol. 11, No. 12, 453-5 (Dec., 1959). In German.

The construction and performance of a box-type absorber is described. The design is based on suggestions by Lenz and Zinke (Abstr.5363 of 1958) and leads to a reflection factor of less than 10% with a smaller physical size than that required for previous types. V.G.Welsby

621.372.6

2250 EQUIVALENT CIRCUITS OF GENERIC MULTIPOLES. G.Biorci and L.Piglione.

Alta Frequenza, Vol. 28, No. 5-6, 528-40 (Oct.-Dec., 1959).

A non-reciprocal passive quadripole can be represented by an equivalent circuit (as far as external behaviour is concerned) which contains only one non-reciprocal 3-terminal element. If the system has n + 1 terminals, it is possible to obtain an equivalent circuit with n/2 3-terminal elements if n is even, or (n−1)/2 if n is odd. A method of obtaining the equivalent circuit with the said minimum number of non-reciprocal 3-terminal elements is given.

621.372.6 : 517.524

2251 FURTHER THEORY OF A CERTAIN CONTINUED FRACTION. O.P.D.Cutteridge.

Proc. Instn Elect. Engrs, Monogr. 367 M, publ. March, 1960, 4 pp. to be republished in Pt.C.

Develops further theory of a certain type of continued fraction relevant to the problem of determining the character of the zeros of a polynomial. Two theorems provide tests for the number of positive zeros, real zeros and pairs of conjugate complex zeros of a real polynomial. Two numerical examples are included, one of which shows the application of the method to a problem in linear-network theory. See also abstr. 1573 (1959).

621.372.6

2252 SOLUTION OF SOME PROBLEMS IN THE PHASE PLANE. J.Hlávka.

Elektrotech. Obzor, Vol. 48, No. 12, 630-4 (1959). In Czech.

Some problems of linear systems can be quickly solved in the phase plane. An analysis of the phase trajectories of transients in RLC series circuits is given and a number of problems, involving unit step voltage, or several unit impulses in such circuits, are solved. The procedure developed permits the graphical determination of transients for arbitrary voltage inputs. N.Klein

621.372.6

2253 NETWORK REALIZABILITY IN THE TIME DOMAIN. A.H.Zemanian.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 3, 288-91 (Sept., 1959).

Two network-realizability theorems on the unit-impulse response matrix of a multiterminal network are developed. They present necessary and sufficient conditions which are satisfied by the unit-impulse response matrix of certain classes of fixed, linear, and passive networks.

621.372.6 : 621.382.3

2254 GRAPHICAL METHODS FOR NETWORK DESIGN INCLUDING TRANSISTOR CIRCUITS. J.Zawels.

Proc. Instn Elect. Engrs, Paper 3116 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl.17, 1108-18, 1119-21 (1959).

A chart for use in general circuit design and particularly the design of circuits employing transistors, analogues to the circle diagrams and charts used in transmission-line and waveguide problems, is described. The chart is based on expressions which specify the devices or networks in terms of their image parameters. Practical examples in transistor circuit design are given, involving the exact calculation of quantities such as input and output impedances, voltage gain, etc. A procedure for the rapid determination of the conjugate matched impedance is also given. By treating feedback in a somewhat unconventional manner, it is shown that the chart may also be used in calculations involved in feedback circuits. Finally, the theoretical experimental determination of the image parameters for transistors is described.

621.372.6

2255 THE CONDITIONS UNDER WHICH THE RESPONSE OF A LINEAR SYSTEM IS MONOTONIC. V.Doležal.

Slaboproudy Obzor, Vol. 20, No. 11, 672-6 (1959). In Czech.

It is required to find the necessary condition for the Laplace transform $F(p)$ of a linear system such that its indicial or transient response $f(t)$ will be monotonic. The function $F(p)$ is said to be totally monotonic in the interval (σ, ∞), if $F(p)$ has the derivatives of all orders, such that $(-1)^k F^{(k)}(p) \geq 0$, where $k = 0, 1, 2 \ldots\ldots$ The ensemble of all the functions which are totally monotonic in (σ, ∞) is denoted by $M(\sigma)$. The main theorem states that the necessary and sufficient condition for $f(t) \geq 0$ in $(0, \infty)$ is that $F(p) \in M(\sigma)$. Nine additional theorems are given (without proof). The systems whose response is monotonic to a monotonic input signal are also considered. The theory is elucidated by five numerical examples.

621.372.63

2256 ANALYSIS OF ACTIVE NETWORKS BY ADMITTANCE MATRICES. M.N.Srikantaswamy and K.K.Nair.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 4, 186-93 (Sept., 1959).

A new method of analysis is presented. The admittance matrices of vacuum tubes and transistors are derived and examples of application are given. The concept of the indefinite admittance matrix as defined by Shekel (Abstr. 444 of 1953) is introduced. The indefinite admittance matrices are then derived for vacuum tubes and transistors and it is shown how one can derive the admittance matrices of the various tube and transistor configurations from their respective indefinite admittance matrices.

WAVEGUIDES

621.372.826 : 621.396.677

THE SURFACE-WAVE AERIAL. See Abstr. 1830

621.372.831 : 538.56

2257 ON THE PERIODIC COUPLING OF PROPAGATING STRUCTURES. N. Rynn.
I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 325-9 (July, 1959).

An analysis of two propagating structures periodically coupled together, based on a method developed by Pierce (see Abstr.2095 of 1954) is presented. A periodic structure that supports a backward wave may be coupled to a structure that supports a forward wave by coupling to alternate cells of the former. The coupling is completely analogous to the case of continuously coupled waves; i.e., energy is transferred back and forth between the two guides periodically and the period of the transfer is inversely proportional to the strength of the coupling. The period of the transfer is also a function of the number of couplers per unit length. A method of measuring the coupling coefficient is presented and application to a coupled-structure attenuator is discussed.

621.372.832.8

2258 NEW MICROWAVE CIRCULATORS. H.N.Chait and T.R.Curry.
Electronics, Vol. 32, No. 51, 81-3 (Dec. 18, 1959).

Results of experiments on several types of Y circulators are given. The circulator described consists of three waveguides meeting symmetrically at a junction in the H-plane. Circulator action results due to ferrite being disposed suitably in the junction region, and magnetized perpendicular to the H-plane. Although the bandwidth of a Y circulator is less than that of some of the other circulators, it is superior in power handling capacity and it is simple and robust. For an X-band circulator using a $\frac{1}{8}$ in. ferrite rod in the centre of the junction, a 50 Mc/s bandwidth, 0.5 dB loss, and isolation better than 30 dB is claimed. Applications to a scanning aerial array are also mentioned. A.E.Karbowiak

621.372.855

2259 MICROWAVE TERMINATIONS. G.Bostick.
Electronics, Vol. 33, No. 2, 50-1 (Jan. 8, 1960).

Characteristics of coaxial and waveguide matched terminations are classified in 4 groups. A tabular comparison of characteristics and relative cost is given. A.E.Karbowiak

OSCILLATORS . PULSE GENERATORS

621.373.3 : 538.56

2260 A NEW MICROWAVE HARMONIC GENERATOR. K.D.Froome.
Nature (London), Vol. 184, 808 (Sept. 12, 1959).

A very short gap mercury arc possesses a non-linear voltage–current relationship. Microwave power is fed into an arc developed between a fine tungsten wire and a mercury pool cathode and the nonlinearity gives rise to harmonic generation. A few watts of input power at 2.5 Gc/s produced 1 mW at 10 Gc/s and also a strong signal at 30 Gc/s. It thus appears that such arcs may provide useful millimetre wave generators comparable with most sources at present in use. G.D.Sims

621.373.4

2261 A VOLTAGE TUNES RESISTANCE-CAPACITANCE OSCILLATOR. W.D.Ryan and F.E.Hetherington.
Electronic Engng, Vol. 32, 108-10 (Feb., 1960).

The variable capacitance exhibited by selenium dry-disk rectifiers with reverse bias is utilized in a bridge-type resistance-capacitance oscillator circuit to produce a variable audio-frequency dependent on an applied d.c. signal. The characteristics of suitable rectifiers, the circuit diagram of the oscillator and its operating characteristics are described.

621.373.4 : 621.365.52

2262 DESIGN OF LAMINATED CIRCUITS FOR INDUSTRIAL R.F. GENERATORS. F.Dittrich.
Mullard tech. Commun., Vol. 5, 26-31 (Dec., 1959).

The laminated circuit described offers a good compromise between efficiency and cost. Manufacturing costs for quantity production are low enough to offset the extra cost of the separate screening necessary. The physical size of the circuit is such that it can be incorporated in existing equipment. It is envisaged that, with standardization to a few preferred sizes of lamina, a manufacturer will be able to assemble tank circuits covering a wide range of supply voltage, operational frequency and loaded-Q.

621.373.4 : 621.316.726 : 538.56

2263 FREQUENCY CONTROL OF AN OSCILLATOR BY NUCLEAR MAGNETIC RESONANCE.
R.V.Pound and R.Freeman.
Rev. sci. Instrum., Vol. 31, No. 2, 96-102 (Feb., 1960).

A simple super-regenerative oscillator that produces a coherent signal at the magnetic resonance frequency of a sample in its coil is described in theory and in practice. A c.w. oscillator is phase locked to the super-regenerative oscillator and the signal which results follows variations in the frequency of magnetic resonance, owing to variations of the field, within less than 5 parts in 10^9; the signal produced is adequately monochromatic and stable enough to be used for magnetic resonance experiments with high resolution. The requirements for time and temperature stabilization of the magnet are very greatly relaxed.

621.373.42

2264 LOW-DISTORTION SINE-WAVE GENERATOR. A.R.Bailey.
Electronic Technol., Vol. 37, No. 2, 64-7 (Feb., 1960).

Describes the development of a very low-distortion oscillator covering the frequency range of 10 c/s to 100 kc/s with a distortion of less than 0.02%. Over the major part of the range the distortion is less than 0.01%.

621.373.42 : 538.56

2265 HOMODYNE DETECTOR FOR REPRODUCTION OF PERIODIC WAVE FORMS. C. Lagercrantz.
J. sci. Instrum., Vol. 36, No. 6, 257-9 (June, 1959).

The principle of homodyne detection is applied to a method of reproducing periodic waveforms in the a.f. range on a pen recorder. The signal is fed to a gate, which is opened by a short reference impulse. The time position of the reference is swept over the signal cycle by aid of a linear phase-shifter, so that all points on the signal curve are consecutively and individually recorded when passed through the gate to an RC filter and finally to the recorder.

621.373.421.14

2266 COMPARISON AND EVALUATION OF CESIUM ATOMIC BEAM FREQUENCY STANDARDS.
J.Holloway, W.Mainberger, F.H.Reder, G.M.R.Winkler, L.Essen and J.V.L.Parry.
Proc. Inst. Radio Engrs, Vol. 47, No. 10, 1730-6 (Oct., 1959).

Standards of different design were compared, and the principal sources of errors in these devices were studied. The unresolved discrepancy found between the standards was about 2 parts in 10^{10}. The characteristics of the standard, sources of errors, and the details of the comparison tests are discussed.

621.373.44 : 621.382.333

2267 AVALANCHE TRANSISTORS AS FAST PULSE GENERATORS. J.L.Moll.
Proc. Instn Elect. Engrs, Paper 3065 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1082-5, 1119-21 (1959).

621.373.5

2268 TWO-CRYSTAL HARMONIC GENERATOR. T.E.Hartman.
Rev. sci. Instrum., Vol. 30, No. 11, 1063-4 (Nov., 1959).

The generator uses coupled waveguides, with a K-band klystron driver. The two crystals are spaced one wavelength of the second harmonic apart so that this harmonic is reinforced. The spacing is adjusted by moving one complete crystal assembly along the guides, allowing the generator to be tuned over a fundamental range of 22.8 to 24.3 kMc/s. The fundamental conversion loss, relative to the 2nd harmonic, is greater than 16 dB. The generator is susceptible to vibration and large temperature changes. W.G.Stripp

621.373.51

2269 GENERATION OF HARMONICS AND SUBHARMONICS AT MICROWAVE FREQUENCIES WITH P-N JUNCTION DIODES. D.Leenov and A.Uhlir, Jr.
Proc. Inst. Radio Engrs, Vol. 47, No. 10, 1724-9 (Oct., 1959).

The performances of a nonlinear resistance and a nonlinear capacitance in a broadband harmonic generator circuit are analysed. The nonlinear capacitance is shown to have a considerably higher efficiency. Some results of harmonic and subharmonic generation experiments with a graded-junction silicon nonlinear-capacitance diode are given.

621.373.52

2270 DESIGNING HIGH-POWER TRANSISTOR OSCILLATORS. W.E.Roach.
Electronics, Vol. 33, No. 2, 52-5 (Jan. 8, 1960).

A new developmental silicon transistor of alpha cut-off frequency between 100 and 200 Mc/s and collector dissipation of 100 W is used for a step-by-step design of an oscillator usable at over 300 Mc/s (0.2 W output) and at 10 Mc/s (100 W output). A.Sczaniecki

621.373.52

2271 TRANSISTOR LC OSCILLATOR CIRCUITS FOR LOW-FREQUENCY, LOW-POWER OPERATION. K.Holford.
Mullard tech. Commun., Vol. 5, 17-25 (Dec., 1959).

A simple procedure is derived for the design of oscillators in either the grounded-emitter or grounded-base configuration. Graphs are shown which relate the three quantities: amplitude of oscillation, oscillator bias and the ratio of peak to mean emitter current, to the amount of feedback applied. The design procedure is suitable for output powers up to about 20 mW and frequencies up to approximately $f_1/50$.

621.373.531.1

2272 CHOOSING TRANSISTORS FOR MONOSTABLE MULTIVIBRATORS. J.R.Kotlarski.
Electronics, Vol. 33, No. 4, 58, 60 (Jan. 22, 1960).

The quasi-stable periodic time is shown to be

$$T_0 = R_\tau C_\tau \log_e (1 + I_c R_L / V_\tau - V_a)$$

for this circuit, where $R_\tau C_\tau$ is the time constant of the coupling network, $I_c R_L$ is the change in p.d. at the collector of the first transistor, and V_τ and V_a are the reference and common emitter–earth p.d's. respectively. Design rules are derived for this circuit and also cover the case in which the quasi-stable period may be ended by an external clock-pulse. J.MacCormack

621.373.531.1

2273 INFLUENCE OF STRAY INDUCTANCE ON THE DURATION OF RELAXATION OSCILLATION IN A BLOCKING OSCILLATOR. V.Špány.
Slaboproudy Obzor, Vol. 20, No. 12, 760-2 (1959). In Slovak.

It is shown that the stray inductance L of the secondary of the transformer in a transistor blocking oscillator (in the grounded-emitter connection) is in series with the coupling capacitance C and the input resistance r of the transistor. A formula for the relaxation pulse of the oscillator is derived. This shows that the duration of the pulse is dependent not only on C, but also on L and r. The effect of L is quite significant. This conclusion is borne out by experiments which are in close agreement with theory.
R.S.Sidorowicz

621.373.531.2

2274 METHOD OF OPERATION OF TRANSISTORIZED BLOCKING OSCILLATORS AND REVIEW OF THEIR BASIC ARRANGEMENTS. W.Hilberg.
Elektron. Rdsch., Vol. 13, No. 9, 330-5 (Sept., 1959). In German.

Transistors are often preferable to valve circuits for blocking oscillators in respect of simplicity, sensitivity and circuit reliability. They are chiefly characterized by the switching speeds, of which a careful analysis is made. Formulae for pulse duration are tabled for nine arrangements of monostable (flip-flop) circuits and ten arrangements for sustained oscillation (multivibrator) circuits.
A.Sczaniecki

621.373.544

2275 SWEEP GENERATOR DESIGN: HOW TO KEEP IT SIMPLE. H.P.Brockman.
Electronics, Vol. 33, No. 3, 92 (Jan. 15, 1960).

The circuit consists of a flip-flop, a transistor-switch, an RC timing network, an emitter-follower and a diode feedback circuit. It is designed for a temperature range of -55° to $+85^\circ$C.
A.Sczaniecki

PULSE CIRCUITS . DIGITAL CIRCUITS SWITCHING CIRCUITS

621.374.3

2276 THE TRANSISTOR IN PULSE CIRCUITS. G.Westerberg.
Tekn. T., Vol. 90, No. 5, 111-19 (Jan. 29, 1960). In Swedish.

Static characteristics of transistors used as relays are discussed, the theory of their operation as open and closed contacts being explained. Dynamic characteristics are derived and a method for increasing the speed of operation of the transistor as a switch is shown. Circuit details of the use of the transistor as a blocking oscillator are given showing it to be very useful when large current pulses have to be generated using few components. The overload protection of this circuit is discussed. A brief account is given of the transistor in relaxation oscillator circuits and in n-p-n–p-n-p coupling. G.N.J.Beck

621.374.3 : 539.1.07

2277 PULSE HEIGHT SELECTOR WITH CONSTANT ANALYSIS TIME. M.Spighel and L.Pénege.
J. Phys. Radium, Vol. 18, Suppl. No. 3, 19A-22A (March, 1957). In French.

A one-channel pulse-height selector with constant analysis time (accuracy of 2×10^{-9}), independent of pulse height, is described. This has been obtained with pulses having 2.5×10^{-7} sec rise-time by correctly selecting a reference time in the pulse. By taking into account the delay of a trigger, the analysis time may be defined with a precision of 5×10^{-9} sec.

621.374.3 : 621.372.54

2278 GENERATION OF A TRANSIENT PROCESS WITH THE PASSAGE OF A VIDEO PULSE THROUGH A LOW-FREQUENCY FILTER BY THE METHOD OF CHARACTERISTIC POINTS. B.V.Elizarov, G.N.Krylov and G.I.Makarov.
Radiotekhnika, Vol. 14, No. 10, 23-31 (Oct., 1959). In Russian.

Generation of transients by video pulses passing through low-frequency filters with an arbitrary number of meshes and arbitrary loads is considered. This is a development of a general argument published previously (see Abstr. 4118 of 1959). An adjustable load and arbitrary resistive and capacitive loads are investigated in turn. T.Horrocks

621.374.3 : 621.372.54

2279 THE PASSAGE OF PULSES WITH LINEAR VARYING CARRIER-FREQUENCY THROUGH A SELECTIVE SYSTEM. I.S.Gonorovskii.
Radiotekhnika i Elektronika, Vol. 3, No. 12, 1485-94 (1958). In Russian.

The effect on a Gaussian filter of pulses having constant and varying amplitude is considered. A general solution is derived for arbitrary relationships between the pulse parameters and the filter. The special cases of a rectangular pulse with linearly varying carrier-frequency and a pulse with exponentially varying amplitude are discussed. [English summary: PB 141106T-11, obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.]. R.C.Glass

621.374.32 : 539.1.07

2280 A FLEXIBLE 20-CHANNEL TIME-DELAY AND PULSE-HEIGHT ANALYSER. EQUIPMENT FOR PULSED BOMBARDMENT STUDY OF SHORT-LIVED NUCLEI IN A CYCLOTRON. P.A.Tove.
Ark. Fys., Vol. 13, Paper 41, 579-607 (1958).

A multichannel pulse analyser is described which is suitable for time-delay analysis of events in the range from 1 μ sec to minutes or more. Applications are lifetime measurements on isomers in this region, and, with auxiliary equipment, pulsed bombardment studies of short-lived nuclei produced in an accelerator. The time sorting is done by count channels which are successively opened and shut. The analyser is easily converted to a pulse-height analyser.

621.374.32

2281 EVALUATION OF THE STABILITY OF THRESHOLD AWAITING DEVICES. I.M.Kogan and I.B.Pogozhev.
Radiotekhnika, Vol. 14, No. 10, 57-63 (Oct., 1959). In Russian.

Devices are considered which give out a pulse upon reception of a "command" signal. Occasionally false operation will occur and this appears to be due to noise. The probability of this occurring is a measure of the stability of the system. The effect of appearance at the input to the device of low-frequency noise, representable by a gaussian uncorrelated stationary stochastic process is considered. Plots of the probability of false operation against a given operating level are shown to have a basically rectangular characteristic, the probability dropping sharply to zero at a certain level.

T. Horrocks

621.374.32

2282 TRANSISTOR-DRIVEN BEAM SWITCHING TUBE DECADE COUNTER. R.H.Graham.
I.R.E. Trans Nuclear Sci., Vol. NS-6, No. 4, 16-20 (Dec., 1959).

Describes an electrical readout decade counter employing a magnetron beam switching tube with transistor drive. Double-pulse resolution is 1 μsec. The unit will accept a variety of transistor types, and will tolerate supply voltage variations of ±20% at ambient temperatures up to 60°C. A "Pixie" neon indicator is driven without the use of additional transistors. A readout circuit for printer or punched paper tape is presented.

621.374.32

2283 FAST COUNTING CIRCUITS USING E1T TUBES. V.Radeka.
Electronic Engng, Vol. 32, 92-5 (Feb., 1960).

The possibilities of fast counting with E1T type counter tubes are investigated. Displacement of the electron beam is considered and time required to reach the stable point calculated. The limits of accurate counting against the reliability required are determined theoretically and experimentally. It is found possible to use E1T tubes up to about 10^8 pulses/sec. A circuit diagram of a reliable fast counting decade suitable for general application is presented. The circuit operation is entirely independent of the input waveform and supply voltage variations. Only one d.c. supply voltage is needed.

621.374.32

2284 AN EVENTS PER UNIT TIME METER (E.P.U.T. METER). J.D.Storer.
Electronic Engng, Vol. 32, 160-2 (March, 1960).

Describes a simplified form of meter which gives a read-out in cycles per second up to 9999. The 1 sec gating waveform is derived from a 1 kc/s crystal oscillator having a long-term stability not worse than one part in 10^4. A separate output is provided from this oscillator for checking the accuracy of count, and for use as an external calibrator. Both manual and automatic resets are provided, enabling the instruments to be used as a straight counter if required.

621.374.32

2285 STEERING CIRCUIT CONTROL REVERSIBLE COUNTERS. R.D.Carlson.
Electronics, Vol. 33, No. 1, 86-8 (Jan. 1, 1960).

Four transistors binary stages provide complementary outputs and either may be made to count up or down by emitter-follower steering transistors in the interstage couplings. The "binary coded decimal excess three" system is used, in which the codes for 3 to 12 represent 0 to 9. This facilitates the elimination of unwanted states by forced resetting. The maximum count rate is 2×10^5 pulses/sec.

W.G.Stripp

621.374.32

2286 IMPROVEMENT OF A DECADE COUNTER USING BINARY STAGES. V.G.Zinov.
Pribory i Tekh. Eksper., 1959, No. 3, 135-6 (May-June). In Russian.

Describes an improved circuit which uses a gating valve with two control grids between the first and second binary stages.

P.Collins

621.374.32

2287 A MODIFIED GATING LOGIC TO IMPROVE THE SPEED OF OPERATION OF DOUBLE RANK COUNTERS.
B.K.Basu and P.V.S.Rao.
Proc. Indian Acad. Sci., A, Vol. 46, No. 5, 354-9 (Nov., 1957).

The speed of operation of double rank counters can be increased by a suitable modification of the gating logic now being used. The improvement in speed, predicted on theoretical grounds, has been experimentally verified. The prescribed logic enables the use of both the ranks of the counter to advantage, one rank counting in the normal, and the other in the reverse fashion.

621.374.32

2288 PULSE-HEIGHT-TO-DIGITAL SIGNAL CONVERTER. W.W.Grannemann, C.D.Longerot, R.D.Jones, D.Endsley, T.Summers, T.Lommasson, A.Pope and D.Smith.
Electronics, Vol. 33, No. 2, 56-60 (Jan. 8, 1960).

The transistorized circuit described provides a 7-digit binary output for an input pulse of 0 to 2 V, at a maximum sampling rate of 13 000 pulses/sec. Data and timing pulses are received on separate lines. The data pulse heights are converted to widths which gate the clock pulses proportionally to data pulse amplitude. These clock pulses are stored in a 7 binary digit counter, the state of which represents the data pulse height, and is subsequently read out at intervals controlled by suitable timing pulses. Circuits are given.

K.C.Garner

621.374.32 : 621.398

2289 DATA CONVERSION CIRCUITS FOR EARTH SATELLITE TELEMETRY. D.N.Carson and S.K.Dhawan.
Electronics, Vol. 33, No. 3, 82-4 (Jan. 15, 1960).

Two alternative transistorized pulse-height-to-time converter circuits are described. In the first, the input accepts a negative pulse amplitude up to 40 V and the first transistor charges a capacitor at a constant rate to the peak value of the input pulse. The second transistor and associated diodes form the comparator which converts this ramp into a pulse of duration proportional to the input pulse amplitude. The alternative circuit accepts up to a 7 V positive going pulse and consists of a pulse-stretching circuit which also maintains the original pulse amplitude. Both circuits are used eventually to gate an oscillator to provide a number of cycles proportional to the time interval and hence to the input pulse height. It is this signal which is intended to be transmitted from the satellite as a measure of pulse amplitude produced by radiation detectors.

K.C.Garner

621.374.32

2290 A UNIVERSAL INPUT STAGE FOR ELECTRONIC COUNTERS. H.Mahnau.
Elektron. Rdsch., Vol. 13, No. 9, 324-7 (Sept., 1959). In German.

A detailed description of valve circuits and their operation, providing the following facilities: (i) input signals, of either polarity, are accepted in the range 0.2 to 100 V; (ii) accurate amplitude threshold control; (iii) pulse-to-pulse dead-time is variable from 2.5 to 20 μsec; (iv) generation of standard pulse, coincident with input impulse or the end of the corresponding dead-time; (v) start–stop gating of counter trigger pulses; (vi) coincidence or anticoincidence recognition of signals from two separate sources: this requires two complete units.

A.Reiss

621.374.32

2291 HISTORY AND INTRODUCTION—MICROWAVE TECHNIQUES FOR COMPUTERS. R.E.Meagher.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 263-5 (Sept., 1959).

621.374.32

2292 NANOSECOND LOGIC BY AMPLITUDE MODULATION AT X BAND. W.C.G.Ortel.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 265-71 (Sept., 1959).

A basic circuit, consisting of a diode modulator controlled by the signal from a diode detector, may perform logical "and",

"exclusive-or" and "or" functions upon pulsed microwave signals. Pulse rates up to 500 Mc/s have been used at a carrier frequency of 11 Gc/s. To demonstrate that microwave circuits may be used for the regeneration and circulating storage of pulses, as well as for logic, a digital arithmetic unit was built which multiplies two 8-digit binary numbers. Various forms of the basic circuit were studied in operation.

621.374.32

2293 FAST MICROWAVE LOGIC CIRCUITS. D.J.Blattner and F.Sterzer.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 297-300 (Sept., 1959).

In a carrier-type digital computer system, binary information can be represented by the presence or absence of an r.f. pulse in a given time interval. Using strip-line printed circuit techniques and point-contact diodes, passive "and" and "not" gates were constructed which operate with r.f. pulses of less than 2 mμsec duration (i.e. an effective pulse repetition rate of 500 Mc/s), at a carrier frequency of 3 kMc/s. The basic gates were combined to form half-adders. Unlike other carrier approaches, these circuits keep the information in r.f. form through all steps of the logic operations; i.e. both inputs and outputs of all elements are r.f. pulses.

621.374.32

2294 MICROWAVE LOGIC CIRCUITS USING DIODES. W.Sauter and P.J.Isaacs.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 302-7 (Sept., 1959).

It is possible to control the transmission of microwave power in a waveguide via external control of the d.c. bias on a semiconductor diode mounted across the waveguide in a direction parallel to the E field. The combination of a microwave detector with such a modulator affords a means whereby r.f. power in one waveguide can be made to control r.f. power in a second waveguide. In order to test the applicability of this circuit to binary logic functions, a regenerative memory loop was constructed. Travelling-wave tubes were employed to raise the level of a controlled signal to that required by the detector. Using an X-band carrier, binary pulse stability was observed at pulse repetition rates of 685 Mc/s.

621.374.32 : 621.382

2295 MICROWAVE SWITCHING WITH COMPUTER DIODES. M.Bloom.
Electronics, Vol. 33, No. 3, 85-7 (Jan. 15, 1960).

The switching characteristics of a number of commercially available diodes are compared and some results are presented in graphical form. A.E.Karbowiak

621.374.32

2296 D.C. DESIGN OF RESISTANCE-COUPLED TRANSISTOR LOGIC CIRCUITS. W.J.Wray, Jr.
I.R.E. Trans. Circuit Theory, Vol. CT-6, No. 3, 304-10 (Sept., 1959).

Worst-case d.c. design equations for resistance-coupled transistor logic circuits are presented and discussed. A solution is chosen in a form which provides for setting switching transient times in advance of calculating the d.c. design. All constants are discussed and the algebraic solution is obtained for values of the unknown resistors and voltages. A numerical example illustrates a typical design with five inputs and five outputs, using the type GT-759 transistor.

621.374.32

2297 PARAMETRIC PHASE-LOCKED OSCILLATOR — CHARACTERISTICS AND APPLICATIONS TO DIGITAL SYSTEMS. L.S.Onyshkevych, W.F.Kosonocky and A.W.Lo.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 277-86 (Sept., 1959).

The ability of the parametric phase-locked oscillator (p.l.o.) to detect, amplify, and store binary digital signals in the form of two distinct phases of a carrier, makes it possible to use the device as the sole component in a digital computer system. The variable-capacitance version operates readily at kilomegacycle frequencies, thus forming the basis of a digital computer at a kilomegacycle clock rate. The results of an investigation of the behaviour and possible applications of the variable-capacitance p.l.o. are presented. The investigation was supported by experimental work with lumped-component variable-capacitance l.p.o's. at 5 Mc/s and microwave variable-capacitance p.l.o's. at 4 Mc/s. The steady-state behaviour of the device is described; variations of the output voltage with pump voltage, loading, tuning and frequency variations are presented in the form of characteristic curves. Results indicate that the device is rather insensitive to reasonable changes in operating conditions and parameter values. The transient behaviour of the p.l.o. shows that the device can be switched in a number of different ways. Five such modes of operation are discussed; these are phase initiation, forced switching, burst generation, tri-stable operation and unconditional switching. Each of these modes has particular advantages for various applications. Switching times of the order of 3 to 10 cycles of the signal frequency are readily obtainable. The various modes of operation of the device suggest a number of applications both in logic and in memory. To illustrate the versatility of the device, a random access memory is described as an example.

621.374.32 : 621.318.1 : 539.2 : 538.2

2298 OPERATING CHARACTERISTICS OF A THIN FILM MEMORY. J.I.Raffel.
J. appl. Phys., Supplement to: Vol. 30, No. 4, 60S-61S (April, 1959).

An experimental prototype memory with 32 ten-bit words has been designed, built, and tested. Circular spots 1/16 in. in diameter about 600 A thick are used. These are evaporated on two pieces of glass each comprising a 16×16 spot array. An operating cycle time of less than one-half microsecond appears possible. The circuitry for driving and sensing is transistorized and the memory uses external register selection from a core-diode matrix. Word selection is provided by a transverse field and a digit winding conditions the information written by applying a longitudinal field in the "one" or "zero" direction. Extension to sizes of the order of 1000 words is planned using these techniques. The memory constructed here will soon be installed in the control element of the TX-2 computer.

621.374.32 : 681.142

2299 HIGH-SPEED DIGITAL STORAGE USING CYLINDRICAL MAGNETIC FILMS.
G.R.Hoffman, J.A.Turner and T.Kilburn.
J. Brit. Instn Radio Engrs, Vol. 20, No. 1, 31-6 (Jan., 1960).

Digital stores consisting of closed magnetic circuits deposited on long glass tubes are described. These promise considerably increased operating speeds compared with present stores, together with the possibility of producing multi-element systems. A system designed to produce 30 tubes with 16 elements per tube in a single evaporation is now operating. Different selection modes which are more suitable for an array of this type have been tested, which permit greater tolerances than conventional selection systems.

621.374.32 : 621.318.1

2300 CORE MEMORY SYSTEMS. A.Ashley, S.Bradspies, E.Cohler, M.Stern and H.Ullman.
Sylvania Technol., Vol. 12, No. 4, 140-9 (Oct., 1959).

A description of general problems in coincident-current core memories is followed by a presentation of new techniques that alleviate or overcome some of the difficulties. Among these are a strobe-compensation technique for greatly increasing reliability with transistor drivers, a new sense amplifier for 4 μs operation, and a temperature-compensation technique that permits reliable operation from −30 to +55°C. The advantages of linear selection in conjunction with core memories are outlined and partial switching techniques are considered. Matrixing methods to minimize the number of drive circuits required are discussed, and a typical linear-selection memory is then described. Finally, new noise-cancelling techniques that will permit very fast operation with simple sensing circuits are shown.

621.374.32 : 621.318.12

2301 ALL-TRANSISTOR MAGNETIC-CORE MEMORIES. B.T.Goda, W.R.Johnston, S.Markowitz, M.Rosenberg and R. Stuart-Williams.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 666-73 (1959) = Commun. and Electronics, No. 45, (Nov., 1959).

The factors limiting the speeds of operation of ferrite-core memories include propagation times, switching times and heating effects. Linear selection systems are preferable to coincident-current operation in small or fast stores. Properties of available cores suitable for transistor drive are described, together with the difficulties associated with some transistor drive circuits. The waveforms used affect the high-speed switching characteristics and should be considered when selecting the core material and the testing procedure. R.C.Kell

621.374.32

2302 LOW TEMPERATURE STORAGE ELEMENTS. E.H.Rhoderick.

J. Brit. Instn Radio Engrs, Vol. 20, No. 1, 37-40 (Jan., 1960).

The philosophy underlying the use of low temperature computer elements is discussed and the cryogenic aspect of the problem briefly reviewed. The most advanced low temperature storage element at the moment is the Crowe cell, in which a persistent current is set up around an aperture in a thin superconducting film, the direction of the current determining whether a 0 or 1 is stored. The switching time of these elements can be as short as 10 mμ sec, and the size is such that between 10^6 and 10^7 can be packed into a cubic foot. The main problem involved in the fabrication of a large memory is that of reproducibility. To exploit the high speed of the Crowe cell it may be necessary to perform the selection and logical operations in the low temperature cryostat. Modifications of Buck's original Cryotron (see Abstr. 3438 of 1956) or avalanche breakdown in a semiconductor could conceivably be used for this purpose.

621.374.32 : 536.48

2303 REFRIGERATION OF A SUPERCONDUCTING MEMORY FOR A COMPUTER. A.C.Rose-Innes.

Brit. J. appl. Phys., Vol. 10, No. 10, 452-4 (Oct., 1959).

An estimate is made of the refrigeration, in terms of consumption of liquid helium, required to maintain at low temperature a memory of superconducting cells. Using commercially available cable, the major source of heat is thermal conduction down the leads to the memory. If a cable of low thermal conductivity is used, a memory of one million cells should not consume more than about 2l. of liquid helium per hour. The optimum size for copper electrical leads running directly from room temperature to liquid helium is calculated.

621.374.32 : 621.315.5

2304 MEASURING CRITICAL CURRENT IN CRYOGENIC CIRCUITS. J.I.Pankove and R.Drake.

Electronics, Vol. 33, No. 4, 52-3 (Jan. 22, 1960).

The critical current ($\sim 10^6$ A/cm^2) in superconductors cannot be maintained and must therefore be measured in a very short time. The device to be tested consisted of two crossed superconducting wires in contact. A current flows from one wire to the other through the contact. Its critical value, at which the contact becomes resistive, is controlled by a second current along one of the wires. A method is described for displaying on an oscilloscope the dependence of the critical value of the first current on the second current.

R.C.Kell

621.374.32

2305 CRYOTRONS AND OTHER SUPERCONDUCTING COMPUTER DEVICES. RECENT ADVANCES. J.M.Lock.

Research, Vol. 13, No. 2, 49-54 (Feb., 1960).

621.374.32

2306 50 Mc DISCRIMINATOR-SCALER. M.Gettner and W.Selove.

Rev. sci. Instrum., Vol. 30, No. 10, 942-3 (Oct., 1959).

A shorter resolving time can be obtained from a bistable flip-flop than from a monostable one. In the transistorized circuit described, the discriminator transistors are coupled by emitter followers. The outputs are differentiated, amplified and mixed so that a flip-flop transition in either direction produces a positive output pulse. Scaling is obtained by using only one flip-flop output. The resolving time is less than 20×10^{-9} sec. W.G.Stripp

621.374.32

2307 10^{-9} SEC RESOLVING TIME COINCIDENCE CIRCUIT BASED ON NEW CURRENT LIMITING EFFECT IN ELECTRON TUBES. F.Lepri.

Rev. sci. Instrum., Vol. 30, No. 11, 1049-50 (Nov., 1959).

The limiting effect is due to the formation of a virtual cathode when the control grid is driven positive. It is used to equalize the amplitudes of pulses in the two valves of a coincidence circuit. The valves have a common anode load shunted by a biased diode.

W.G.Stripp

621.374.32 : 539.1.07

2308 A COINCIDENCE CIRCUIT FOR SMALL AMPLITUDE PULSES. Yu.K.Akimov.

Pribory i Tekh. Eksper., 1959, No. 3, 134 (May-June). In Russian.

The circuit is such that when a single pulse is fed into it (0.03 - 0.3 V) the output pulse is 0.01 - 0.02 V, while if two coincident pulses in the above range are applied, the output pulse is 2.5 - 50 times greater than either of the input pulses. For input pulses up to 8 V, this ratio can reach a value of 50 - 100.

S.Chomet

621.374.32 : 621.318.5

2309 THE NUMERICAL–GRAPHICAL METHOD IN THE DESIGN OF MULTITERMINAL SWITCHING CIRCUITS. A.H.Scheinman.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 515-19 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Each input variable has a binary weight associated with it and each row of the table of combinations can then be represented by a decimal number; the switching function can then be specified by a series of decimal numbers. A changeover contact of the most heavily weighted variable is then introduced. All decimal numbers less than the weight of this variable are placed in series with its "break" side and all numbers equal to or greater than it are placed in series with its "make" side. The new functions are examined for possibilities of combination and simplification according to stated rules. In the application to multiterminal circuits, two methods may be adopted, depending on whether or not more than one output is to be connected at any one time, and a method of extending the simpler method to the more general case is also described.

G.A.Montgomerie

621.374.32 : 621.318.5

2310 APPLICATION OF BOOLEAN ALGEBRA TO THE DESIGN OF SWITCHING CIRCUITS. A.K.Choudhury.

J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 3, 146-51 (June, 1959).

It is pointed out that for design of a circuit requiring the minimum number of elements the Boolean function must be minimized by either an algebraic or graphical method. A graphical method developed for minimizing a Boolean function is described.

621.374.32 : 621.318.5

2311 ALGEBRAIC TOPOLOGICAL METHODS FOR THE SYNTHESIS OF SWITCHING SYSTEMS. III. MINIMIZATION OF NONSINGULAR BOOLEAN TREES. J.P.Roth; E.G.Wagner.

I.B.M. J. Res. Developm. Vol. 3, No. 4, 326-32, 332-44 (Oct., 1959).

For Pt I see Trans. Amer. Math. Soc. Vol. 88, 301-26 (July, 1958). For Pt II see Proc. International Symposium on the Theory of Switching, Harvard University, April 2, 1957. An algorithm is given for solving a general problem in combinational switching-circuit minimization theory. The circuits considered consist of a disjunction (OR-ing together) of trees of any set of logical elements, with the restriction that in any given tree no input appears more than once. To each logical element is attached a positive cost. A method is presented for designing a minimum-cost circuit of this variety for any given logical function. Two parallel treatments are given, one viewing it as an abstract mathematical problem, the other considering it as an engineering problem.

621.374.32 : 621.382.3

2312 TRANSISTOR SWITCHING SPEED. P.M.Thompson and J.Bateson.

Wireless Wld, Vol. 65, No. 11, 530-3 (Dec., 1959).

A brief description is given of the concept of space-charge control of a switched transistor. The effect of hole storage on switching speed is described and the operation of circuits necessary for the production of a base-current control signal is described. Low-level logic circuits which are used to avoid the collector capacitance effects are outlined. J.MacCormack

621.374.4

2313 A TRANSISTOR MIXER EQUIVALENT CIRCUIT. H.Beneking.

Arch. elekt. Übertragung, Vol. 13, No. 7, 313-9 (July, 1959). In German.

Commencing from the hybrid-pi equivalent circuit for a common-emitter amplifier, and assuming that the primary effect of a local-oscillator current bias applied to the input is to modulate the internal base-to-emitter conductance and the mutual conductance components, expressions are derived for the input and forward transfer conversion conductances, both for small and large local-oscillator amplitudes. Stability and neutralization are briefly considered. Experimental data is given which is in good agreement with the theory. F.F.Roberts

621.374.4

2314 SUM AND DIFFERENCE MIXER DESIGN CHARTS. R.F.Baum.
Electronics, Vol. 32, No. 50, 67-70 (Dec. 11, 1959).

When two frequencies f_1 and f_2 are heterodyned, the frequency produced is given by $f_m = n_1 f_1 + n_2 f_2$, where n_1 and n_2 are integers. If the circuits are all linear and the input frequencies free from harmonics, $n_1 = 1$, $n_2 = \pm 1$. In all practical cases further frequencies are produced, corresponding to further values of n_1 and n_2. A chart is given from which these further frequencies may be read off with a view to providing a wideband filter to absorb them. A worked example is given in which allowance is made for the bandwidth of the input frequencies. N.Corcoran

621.374.42

2315 A STABILIZED LOCKED-OSCILLATOR FREQUENCY DIVIDER. P.R.Scott, Jr.
Proc. Inst. Radio Engrs, Vol. 48, No. 2, 192-200 (Feb., 1960).

An analysis of a simple oscillator designed for stabilized frequency-divider application. The oscillator combines some of the characteristics of sinusoidal and relaxation oscillators to provide a high degree of frequency stability while allowing sufficient tendency for synchronization. The analytical results are obtained in a graphical form which is easy to handle and which could be used as a design procedure for stabilized frequency-dividers. Synchronization of the oscillator is described for the case of an input signal consisting of narrow pulses. It is shown that the circuit can maintain a given frequency division ratio regardless of variations in the amplitude of such a synchronization signal. The results of the graphical analysis are confirmed by experimental observations. Performance data are presented indicating that the circuit is capable of frequency division ratios of 30 to 40 without requiring close control of the power supply voltage.

621.374.44

2316 PULSE GENERATOR FOR PRODUCING A SPECTRUM WITH CONSTANT AMPLITUDE IN FREQUENCY RANGE 0.1 TO 30 Mc/s. G.Bittner.
Elektrotech. Z (E.T.Z.) A, Vol. 80, No. 21, 762-4 (Nov. 1, 1959). In German.

A description of apparatus producing practically constant amplitude of signal in the mentioned range of frequencies. This is achieved by generation of pulses of 85 V, 0.8×10^{-9} sec duration, at a repetition frequency of 1, 2, 10, 20 or 100 c/s. The pulses are formed by a delay line, which is charged and discharged via a mechanical switch and relay. The apparatus serves mainly for testing interference-measuring equipment, but it can have also many other uses. A.Woroncow

621.374.44 : 537.52

2317 SQUARE-WAVE GENERATOR FOR THE STUDY OF EXPLODING WIRES. T.J.Tucker.
Rev. sci. Instrum., Vol. 31, No. 2, 165-8 (Feb., 1960).

A 100-kV coaxial cable square-wave generator producing a 2000 A, 3-μsec duration, 6-mμsec rise time, current pulse has been constructed for the study of exploding wires. Unlike conventional capacitor sources the circuit behaviour is described by algebraic rather than nonlinear differential equations, thus allowing easier and surer interpreation of results. Using coaxial-cable techniques for the entire system also provides mμsec resolution of current and voltage wave forms. The system features an output timing pulse, occurring 1.5 ± 0.005 μsec prior to the beginning of the wire explosion which provides triggering for oscilloscopes and for a 5-mμsec exposure time Kerr-cell camera. The electrical isolation of the output trigger pulse from the monitored signal also eliminates waveform distortion produced by trigger circuit loading and signal delay.

621.374.5

2318 A PULSE DELAYING DEVICE. A.Karaminkov.
Hochfrequenztech. u. ElektAkust., Vol. 68, No. 2, 42-9 (July, 1959). In German.

A sine wave is formed from periodically repeated pulses and its phase shifted by the required amount about the limits 0-360°. The pulses are finally regenerated from the sine wave. In this way, pulses can be delayed by any amount up to 10^9 μs. Experimental equipment is briefly described. A.Woroncow

AMPLIFIERS

(Abstracts on magnetic amplifiers appear also under Inductors . Reactors)

621.375.2 : 621.396.7

2319 THE [BERLIN] UNIVERSITY UNIVERSAL MIXING CONSOLE FOR EXPERIMENTAL PURPOSES. F.Winckel.
Elektron. Rdsch., Vol. 13, No. 7, 247-53 (July, 1959). In German.

The ever-increasing demands of mixing consoles, particularly with regard to the number of input channels, in broadcast studios are reviewed and several existing consoles briefly described. The particular design studied caters for eleven input channels. The microphone, intermediate and output amplifiers, together with the equalizing networks and monitoring facilities, are described in detail. H.G.M.Spratt

621.375.2

2320 PUSH-PULL AMPLIFIER BALANCE. USE OF NEGATIVE VOLTAGE FEEDBACK.
Electronic Technol., Vol. 37, No. 1, 41-3 (Jan., 1960).

It is possible to equalize the gains of the two halves of a push-pull pentode output stage by introducing current feedback from the cathode resistors but the result is an unwelcome increase in apparent output resistance. Voltage feedback is normally impossible since the voltages across the two halves of the output transformer primary are automatically maintained equal through mutual inductance. By inserting between the transformer centre tap and the h.t. positive feed an inductance L/4 and a resistance R/4 in parallel, where L is the transformer primary inductance and R is the load referred to the primary side, the a.c. voltage across either half of the primary winding is made dependent upon its associated current only. H.G.M.Spratt

621.375.2

2321 NONLINEAR DISTORTION REDUCTION BY COMPLEMENTARY DISTORTION. J.R.Macdonald.
I.R.E. Trans Audio, Vol. AU-7, No. 5, 128-33 (Sept.-Oct., 1959).

Nonlinear distortion produced in a given circuit can be reduced by pre- or post-distorting the signal applied to or from the circuit. Such complementary distortion cannot reduce the original distortion to zero in practice because of distortion of distortion, but it can result in greatly reduced output distortion over a limited amplitude range. General results for the design of pre- or post-distortion circuits are given, and the mathematical results are illustrated by comparing the total harmonic distortions obtained with pre- and post-distortion corrections of increasing complexity applied to a simple nonlinear circuit.

621.375.2

2322 AMPLITUDE DISTORTION AS A FUNCTION OF FREQUENCY. C.C.Street.
J. Audio Engng Soc., Vol. 5, No. 3, 120-1 (July, 1957).

The variation in output impedance of triodes, and to some extent pentodes, as a function of instantaneous current leads to a type of distortion not usually taken into consideration. Detailed evaluation of the characteristics at the extremes of current excursion indicate the source of a distortion that is both a function of frequency and amplitude for a given circuit design. The means by which the effects of this nonlinear behaviour may be computed and avoided within the limits specified for the behaviour of the circuit are given.

621.375.2

2323 FOUR-VALVE, THREE-WATT STEREOPHONIC AMPLIFIER. P.F.Dallosso.
Mullard tech. Commun., Vol. 5, 10-12 (Dec., 1959).

621.375.222 : 537.7

2324 HIGH-GAIN D.C. AMPLIFIER FOR BIOLOGICAL PURPOSES. S.V.Hill.
J. sci. Instrum., Vol. 36, No. 7, 297-300 (July, 1959).

A "starved operation" d.c. amplifier is described, having a drift of less than 100 μV in 30 min, grid current less than 10^{-11} A and a noise level referred to in the input of 15 μV with 10 MΩ grid resistors. Circuits are also described for using the amplifier with commercial cathode-ray and pen oscillographs.

621.375.223

2325 A SIMPLE DESIGN OF SELECTIVE AMPLIFIERS WITH RC NETWORKS OF THE SYMMETRICAL TWIN-T TYPE. J.Vepřek.

Slaboproudy Obzor, Vol. 20, No. 12, 740-4 (1959). In Czech.

A twin-T symmetrical RC network is connected in the feedback loop of an amplifier, between a voltage source having an output resistance R_1 and a load R_2. Depending on the amount of feedback employed, the selectivity of the system can be made much greater than that of the RC network alone. Since the design of such an amplifier is laborious, a set of suitable design graphs was constructed. These illustrate the dependence of the output voltage of the amplifier and its feedback factor on R_1 and R_2 and the amplifier gain, and the dependence of the input impedance of the network on R_2 and frequency. R.S.Sidorowicz

621.375.23 : 537.7

2326 APPLICATION OF DELAYED FEEDBACK IN ELECTRONIC CIRCUITS. Z.Naray.

Brit. J. appl. Phys., Vol. 10, No. 9, 400-3 (Sept., 1959).

By the use of suitable delayed feedback (d.f.b.) from the output terminals of a four- (or two-) pole network to the input, a great variety of different signals can be generated, the shape of which is determined by the characteristics of the four- (or two-) pole network, the d.f.b. loop and, under certain conditions, by the shape and duration of the trigger signal which is needed to set the d.f.b. system in operation. Two simple applications of delayed feedback in electronic circuits (where the loop gain is real and equal to or less than unity) are given: (a) the output of a phase-inverting amplifier (amplification, $-g$) is fed by a delay line (delay time τ) to the input of the amplifier. If $|g|v \cong 1$ (where v is the loss in the d.f.b. loop), periodic signals of frequency $f \cong 1/2\tau$ are generated. (b) If, in the same arrangement as (a), $|g|v < 1$, an output signal is produced only if a trigger signal is fed into the d.f.b. loop; that is, the circuit works as a triggered oscillator of frequency $f \cong 1/2\tau$. Because of mixing (additive or multiplicative) between the trigger signal of duration T and the d.f.b. signal, the shape of the output signal depends on the value T/τ. By investigation of the output signal with a frequency meter or oscilloscope, the delay time of an unknown element (delay line e.g. amplifier) connected in the feedback loop can be measured. The d.f.b. oscillators have a frequency stability of about 10^{-8}/h.

621.375.3

2327 A MAGNETIC AMPLIFIER E.M.F. CONVERTER. H.E.Darling.

A.I.E.E. Analog and Digital Instrumentation Conference Paper, p. 149-64. See Abstr. 3875 (1959).

Two magnetic amplifiers in series are used to convert a thermocouple voltage of 0-2 or 0-10 mV (input impedances respectively 8 kΩ and 40 kΩ) to an output of 10-50 mA into a 600Ω load. Linearity is 0.25%, a 300Ω load-change produces less than 0.25% output current change, the equipment works under a temperature of 70°F above ambient, and cold-junction compensation and zero elevation are available by adding to the input a voltage from a precision Zener diode source. The first magnetic amplifier has heavy feedback and is capable of sensing currents of the order of 10^{-9}A. Full circuit and constructional details are given. G.A.Montgomerie

621.375.3 : 621.318.435.3

2328 TRANSDUCTOR [AND MAGNETIC AMPLIFIER] TECHNOLOGY.

A.E.G. Mitt., Vol. 49, No. 8-9, 329-452 (Aug.-Sept., 1959). In German.

This issue contains 14 papers on magnetic amplifiers and transductors. Apart from contributions on the history of the art, basic concepts, fundamental theory, and symbols and characteristic curves which are commonly employed, there are papers on the dynamic behaviour of amplifiers and the effect on their characteristics of eddy currents, the choice of magnetic materials, and the properties of associated rectifiers. A typical standard series of amplifiers is described as well as methods adopted for testing them under production conditions. Various kinds of circuit connections are reviewed and applications are described to the problems of frequency-changing, frequency-multiplication and voltage stabilization. S.C.Dunn

621.375.3 : 621.318.1

2329 BIBLIOGRAPHY. LIST OF LITERATURE ON MAGNETIC AMPLIFIERS AND CONTACTLESS MAGNETIC ELEMENTS FOR 1956 (SUPPLEMENT).

Avtomat. i Telemekh., Vol. 20, No. 3, 376-80 (1959). In Russian.

621.375.3

2330 PARALLEL-CONNECTED MAGNETIC AMPLIFIER. K.J.Srivastava.

J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 4, 200-6 (Sept., 1959).

A mathematical analysis of parallel-connected magnetic amplifiers with inductive and capacitive load is presented. The analysis is based on the representation of the normal magnetization curve of the core material by polynomials of third and fifth degree respectively.

621.375.3

2331 ANALYSIS OF MAGNETIC AMPLIFIERS WITHOUT DIODES. P.R.Johannessen.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 477-85 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

An attempt is made to replace the ad hoc method of analysis used for magnetic amplifier circuits with a general and organized method. Although this may not be the shortest one for a particular circuit, it gives a clear insight into the overall properties of magnetic amplifiers. The method starts from a set of linear differential equations relating the average values of voltage and current at the ports (terminal-pairs). For most circuits this representation gives values which are accurate to within 1% or 2% of actual values for a large variety of waveforms of port and supply voltages. Three reasons are given for this remarkable accuracy: control circuit, output circuit and load resistances are all small compared with equivalent magnetizing resistance; almost all practical amplifiers of this type are interconnections of basic elements such that quiescent currents tend to cancel at the ports; the state of the saturable reactor, saturated or unsaturated, depends on the integral of the inductor voltage rather than the inductor voltage itself. Much attention is given to demonstrating the basic laws of interconnection of reactors considered as 4-terminal networks. A matrix calculus is described and an example given of the analysis of a 3-phase amplifier. S.C.Dunn

621.375.3

2332 ANALYSIS OF MAGNETIC AMPLIFIERS WITH DIODES. P.R.Johannessen.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 485-504 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

A method of analysis has been described applicable to magnetic amplifiers without diodes which gives accurate results (see previous abstract). When diodes are included, the back impedance of the diode and the control-circuit impedance are usually of the same order of magnitude as the equivalent magnetizing resistance. The accuracy of the saturable-inductor model is thus of paramount importance in the design of a good analytical model. Although the inclusion of diodes does not destroy the property of quiescent-current cancellation, it does not necessarily follow that steady-state characteristics are linear. The diode characteristic is represented by a piece-wise linear graph. Two different models of the saturated inductor are used, one to determine quiescent operating conditions and another to represent a saturated inductor in an incremental-linear circuit. The various states that the elements can occupy results in there being six different combinations of elements during the course of the analysis. It is shown that there are waveform restrictions in circuits containing diodes. Typical waveforms that satisfy the ideal restrictions are: (1) direct input voltage and rectangular supply voltage; (2) alternating input voltage of the same waveform as the supply voltage; (3) input voltage of the same waveform as half-wave or full wave rectified supply voltage; and (4) input voltage of the same waveform as the sum of the supply and output voltages. As an example a doubler circuit is analysed by the proposed method. S.C.Dunn

621.375.3

2333 GRAPHICAL ANALYSIS OF FULL-WAVE MAGNETIC AMPLIFIER CONTROL CHARACTERISTICS AFFECTED BY CONTROL-CIRCUIT RESISTANCE. K.Murakami and T.Kikuchi.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 526-30 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

When a highly oriented magnetic core with rectangular hysteresis loop is used, the control–magnetization curve (c.m.c.) coincides very well with flux-control characteristics produced by direct-voltage reset. This experiment fact enables the interpretation of the c.m.c. as the relation between the rate of flux change and the instantaneous magnetizing current. By combining these observations with a method

of graphical analysis is it possible to show how the control characteristics are affected by the resistance of the control circuit. Although only the steady-state behaviour is examined, transient phenomena can be discussed from the same viewpoint. S.C.Dunn

621.375.3

2334 THE WINDING CAPACITANCES IN MAGNETIC AMPLIFIERS. I.Johansen.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 702-7 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

A lumped equivalent winding capacitance has been defined which is limited to cases where the winding under consideration has a much larger number of turns than any other winding on the core. An empirical expression has been proposed which gives the capacitance as a linear function of the inner surface area of the winding. Measurements prove that the results are accurate to within better than ± 30%. A number of simple experiments are described which are based on the fact that two magnetic amplifiers which are identical in other respects will behave in the same way when the product of the equivalent capacitance and turns-squared is the same. It is shown that in certain cases the distributed capacitance has the same effect as an external shunt capacitance at the winding terminals. S.C.Dunn

621.375.3 : 621.383.4

2335 MAGNETIC AMPLIFIER FOR PHOTOCONDUCTIVE CELL.

Electronic Applic., Vol. 19, No. 4, 139-46 (1958-59).

A simple magnetic amplifier of the reset type is described which is particularly suitable for direct control by a cadmium-sulphide photoconductive cell, such as the ORP 30 or ORP 90. Although the maximum permissible dissipation of these cells is only 1 W, the arrangement described can be used to control loads of up to approximately 100 W.

621.375.3

2336 CAPACITIVELY COUPLED MAGNETIC AMPLIFIERS. H.W.Collins.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 707-12 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

A high performance a.c. magnetic amplifier can be constructed by using a high-carrier frequency and capacitively coupling the signal-frequency power to the load. This technique realises the advantages of true a.c. amplifiers which include freedom from the effects of d.c. drift, consequent increased sensitivity, elimination of an input demodulator, inherent phase sensitivity, and accurate reproduction of the input waveform. A 3-stage amplifier has been built which has an equivalent noise level of 5 μV, or 10^{-12} watts, and requires a 60 c/s signal of 50×10^{-12} watts to produce full output. Circuit values are given and the core material is ½-mil Mo-permalloy. S.C.Dunn

621.375.4

2337 A TWO-WATT TRANSISTOR AUDIO AMPLIFIER. W.D.Roehr.

I.R.E. Trans Audio, Vol. AU-7, No. 5, 125-8 (Sept.-Oct., 1959).

For low distortion, power transistors should be driven from a low impedance source. Thus an emitter-follower driver has definite appeal. A further advantage is that the driver transistor may be direct coupled to the output transistor. The basic design method for this is described and performance is illustrated. Important considerations such as stability, transistor interchangeability, frequency response, and distortion are discussed and typical measurements shown. The features of this circuit are: good stability and the fact that transistor parameters are noncritical, no bias adjustments are required, frequency response is flat over the audio range and distortion is low.

621.375.4 : 621.376.4

2338 SEMICONDUCTOR DIODE AMPLIFIERS AND PULSE MODULATORS. W.H.Ko and F.E.Brammer.

I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 341-7 (July, 1959).

The reverse recovery characteristic of a semiconductor diode depends not only on the crystal properties and the physical dimensions of the diode but also on the circuit in which it is used. The effects of forward current, reverse voltage and reverse loop impedance on diode recovery characteristics were studied experimentally on germanium and silicon junction diodes. The results are given in curves which illustrate the relationships between these circuit parameters and the maximum reverse current, as well as the constant current duration. Based on these curves, circuit applications were developed. The experiments on a pulse amplifier performed by the National Bureau of Standards were repeated. The results showed a maximum power gain of 22 dB per stage. Four pulse-modulator circuits were designed. They are amplitude modulator, sampler, pulse duration and position modulators. Linearity and frequency response tests on these modulator circuits were conducted. The results indicated that they have small distortion and flat frequency response from d.c. up to several tens of kilocycles per second. Modifications of the pulse amplitude modulator provides amplifiers for continuously varying signals. Four such circuits are given.

621.375.4 : 621.397.331.222

2339 TRANSISTORS IN VIDEO EQUIPMENT. P.B.Helsdon.

J. Brit. Instn Radio Engrs, Vol. 19, No. 12, 753-68 (Dec., 1959).

Principles involved in the design of video current amplifiers for television using transistors are discussed in terms of the hybrid-pi equivalent circuit. The importance of the current gain–bandwidth factor is emphasized and a design philosophy which exploits an unconventional concept of gain–bandwidth is presented. An investigation of noise with regard to camera head amplifier design gives the transistor parameters and circuit conditions necessary for maximum signal/noise ratio. Experimental confirmation shows transistors to be comparable with valves in this application.

621.375.4 : 621.395.625.3

2340 A LOW-COST TRANSISTORIZED RE-RECORDING MIXER. G.A.Brookes, G.W.Read and E.W.Templin.

J. Soc. Motion Picture Televis. Engrs, Vol. 68, No. 9, 589-93 (Sept., 1959).

A compact table-mounted six- or eight-input, single-channel re-recording mixer has been designed for small studio application. Transistorized modular subassemblies provide each mixer circuit with gain control, programme and midrange equalizers; an additional transistorized module includes an overall gain control and test oscillator. Complete mixer console facilities have been incorporated.

621.375.4

2341 DIRECTLY COUPLED TRANSISTOR HEARING AID. D.L.Jones.

Mullard tech. Commun., Vol. 5, 2-9 (Dec., 1959).

The advantage of the system described is that, apart from the usual microphone, earpiece, battery and volume control, the only components required are three transistors, three resistors and one capacitor. A microphone e.m.f. of 200 μV produces an output of 500 mV across a 600Ω earpiece. This corresponds, with a conventional microphone and earpiece, to an air-to-air gain of about 48 dB. The output corresponds to an air pressure of 46 dB above 1 dyn/cm^2. The loss of gain at 0 and 39°C is about 6 dB, and the corresponding reduction in maximum output power is 2.5 dB. Total current consumption at 25°C is 2.8 mA at 1.3 V, giving a life of about 90 hr with a typical mercury cell.

621.375.4

2342 USE OF THE SILICON RESISTOR IN THE D.C. STABILIZATION OF TRANSISTOR CIRCUITS. J.T.Zakrzewski and D.H.Mehrtens.

Nature (London), Vol. 184, 811-12 (Sept. 12, 1959).

If a silicon resistor is used in the emitter circuit of a silicon transistor common-emitter stage, the collector current shows only small changes over a temperature range from −40° to +150°C. The resistor had a positive temperature coefficient of 0.7% per deg C, and for best results was put in parallel with a carbon resistor of predetermined value. Similar results were obtained for power transistors by putting the silicon resistor in the base circuit. C.Hilsum

621.375.4

2343 LOCKED DETECTION WITH TRANSISTORS. K.Homilius.

Arch. tech. Messen, No. 281, (Ref. Z 52-12), 129-32 (June, 1959). In German.

After a brief discussion on disadvantages and application difficulties of mechanical choppers and thermionic valves for d.c. amplifiers, the use of transistors as switches is considered in detail. Families of transistor characteristics (Ie v. Ue with U_b as parameter) are reproduced and used to determine optimal switching characteristics; the emitter-collector path changes from high resistance to low according to polarity of base input drive signal. It is

essential that the characteristics of both closed and open switch intercept not at O but in the 3rd quadrant (i.e. Ie and Ue both negative). Both reverse resistance and short-circuit emitter current depend considerably on ambient temperature, whereas closed switch operation is less affected. The equivalent circuit is discussed next and used to derive the lowest measurable signal, the operational range and obtainable accuracy. To cope with high open-circuit potential across the switch, the use of a parallel transistor with an input pulse of opposite polarity is recommended. Hole storage- and emitter-collector capacitance effects on switching speeds are discussed next. A complete circuit diagram of a chopper with self-contained drive generator, using 8 transistors, is reproduced, and its operation and performance are described in detail.

A.Landman

621.375.422

2344 A LOW-DRIFT TRANSISTOR CHOPPER-TYPE D.C. AMPLIFIER WITH HIGH GAIN AND LARGE DYNAMIC RANGE. I.C.Hutcheon and D.Summers.
Proc. Instn Elect. Engrs, Paper 3227 M, publ. March, 1960, 11 pp. To be republished in Vol. 107B (1960).

Describes a transistor chopper-type d.c. amplifier which is intended for use in the field of process measurement and control. It has a voltage drift below ±10 μV and a current drift below $\pm 4 \times 10^{-9}$ amp. The forward gain in the steady state is about 10 kV/μA and 15 volts/μV, and, in consequence, the full output swing of 0 to 5 volts is provided by an input signal little greater than the drift. The application of sufficient overall negative d.c. feedback therefore enables input signals of 0-10 mV or 0-4 μA to provide full output with an accuracy of ±0.1%. The low drift is obtained by operating the transistor chopper at 200 c/s, stabilizing its temperature within $\pm 2^{\circ}$C, and providing suitably stable waveforms to drive the transistor and compensate for its voltage offset. The a.c. gain prior to the demodulator is only 50 volts/μA, the remaining voltage gain, of about 200, being provided by a low-drift d.c. amplifier which is connected as a feedback integrator and used to smooth the demodulated output. This arrangement enables the system to handle, with a minimum of saturation, the large error signals which occur during a rebalancing operation, and thus maintain a fast response to large changes of input signal. The system is first analysed in general terms, and expressions are derived which describe its performance and act as a guide to the design of this type of amplifier.

621.375.425

2345 DESIGN OF TRANSISTOR I.F. AMPLIFIER DETECTOR STAGES WITH STABILIZED BAND-PASS CHARACTERISTICS. M.V.Joshi.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 4, 223-9 (Sept., 1959).

Data are presented regarding a transistor i.f. amplifier stage employing partial neutralization and operating at low collector voltages. The gain of such a stage can be controlled by varying the collector voltages. A transistor collector detector stage can also provide, besides the demodulated a.f. signal, the control voltage necessary to secure a.g.c. for the preceding h.f. stages. A modified circuit of such a detector stage is presented and this can be employed to drive simultaneously I_e-controlled and V_C-controlled transistor stages. Performance data for such a detector stage and a method of connecting in tandem an I_e- and a V_C-controlled stage are demonstrated. The resulting i.f. amplifier and detector stages have band-pass characteristics that are stabilized with respect to the utilization of the a.g.c. The design provides a means of solving stabilization problems in transistorized equipment. See also Abstr. 5963 (1959).

621.375.43 : 621-526

2346 A TRANSISTOR–THERMISTOR FEEDBACK QUADRATURE SUPPRESSOR.
I.C.Hutcheon and D.N.Harrison.
Electronic Engng, Vol. 32, 87-91 (Feb., 1960).

Quadrature effects in a.c. servo systems are eliminated if the amplified residual signal is demodulated and used to control a negative feedback signal precisely in quadrature phase with the a.c. reference. A design of suppressor is described which uses transistor pre-amplification and two indirectly heated thermistors to control the feedback.

621.375.9 : 538.56

2347 THE OPTIMUM LINE WIDTH FOR THE TRANSITION USED IN A REFLECTION CAVITY MASER AMPLIFIER. G.J.Troup.
Austral. J. Phys., Vol. 12, No. 3, 218-21 (Sept., 1959).

The line width of the amplifying transition in a reflection cavity maser is shown to have an optimum value, which will give maximum amplification bandwidth at a fixed gain. Difficulties associated with achieving the optimum line width in practice for the paramagnetic maser are briefly discussed.

621.375.9

2348 SOLID-STATE MASER AMPLIFIER. S.A.Ahern.
Electronic Technol., Vol. 37, No. 2, 59-63 (Feb., 1960).

The physics of maser operation, including the criteria used for selection of materials is introduced. A description is given of a practical cavity maser, and the system applications discussed. Possible future developments, in particular the travelling-wave maser, are briefly discussed.

621.375.9 : 538.56

2349 OPERATING CHARACTERISTICS OF A MOLECULAR-BEAM MASER. H.G.Venkates and M.W.P.Strandberg.
J. appl. Phys., Vol. 31, No. 2, 396-9 (Feb., 1960).

General expressions for the emitted power and the frequency pulling in an ammonia maser are deduced. The operating characteristics of the maser are deduced by introducing a mean-square time of flight of molecules in the cavity.

621.375.9 : 538.56

2350 AN INTRODUCTION TO THE THEORY OF SOLID-STATE MASERS WITH PARTICULAR REFERENCE TO THE TRAVELLING WAVE MASER. P.N.Butcher.
Proc. Instn Elect. Engrs, Paper 3220E, publ. Feb., 1960, 11 pp. To be republished in Vol. 107 A (1960).

The relevant properties of paramagnetic ions are described and the quantum theory of maser action is outlined qualitatively. A semi-classical treatment is developed which is based on the classical equation of motion of a magnetic dipole. It is used to evaluate the engineering characteristics of a travelling-wave maser which employs the comb type of slow-wave guide.

621.375.9

2351 THEORY OF THE DIODE VARIABLE-REACTANCE AMPLIFIER WITH PARALLEL [TUNED] CIRCUITS. W.Dahlke, R.Maurer and J.Schubert.
Arch. elekt. Übertragung, Vol. 13, No. 8, 321-30 (Aug., 1959). In German.

A useful detailed review of the theory of up- and down-convertors and of straight amplifiers based upon the use of a variable-capacitance diode coupling the parallel-tuned circuits representing the input and output circuits, the local-oscillator drive being also in series with both input and output circuits. The following aspects are among those considered : basic small-signal 4-pole equations; equivalent circuits; bandwidth and stability; noise characteristics; power efficiency; design for maximum gain with minimum noise figure.

F.F.Roberts

621.375.9

2352 CONTRIBUTION TO THE STUDY OF PARAMETRIC AMPLIFIERS. G.Marie and Y.Angel.
C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 311-13 (Jan. 11, 1960). In French.

The operating properties including insertion gain, noise temperature and bandwidth of various kinds of variable-reactance amplifiers are analysed. S.A.Ahern

621.375.9

2353 T.W.T'S. AND PARAMPS. FOR LOW-NOISE RECEPTION. D.A.Watkins and G.Wade.
Electronics, Vol. 32, No. 49, 106-9 (Dec. 4, 1959).

Compares the operating principles and characteristics of travelling wave tubes and parametric amplifiers with particular reference to noise figure. R.C.Glass

621.375.9

2354 FAST WAVE COUPLERS FOR LONGITUDINAL BEAM PARAMETRIC AMPLIFIERS.
A.Ashkin, W.H.Louisell and C.F.Quate.
J. Electronics and Control, Vol. 7, No. 1, 1-32 (July, 1959).

The theory and design for fast wave helix couplers are given. The t.w.t. equations are put in coupled mode form. A matrix formulation of these equations is used to point out a formal mathematical analogue of the Schrödinger equation of quantum mechanics. This analogue is used to suggest possible techniques of solution and may

lead to hitherto unexplored methods of treating this problem. Two special cases are treated. The formulation is equivalent to that used by Haus and Robinson (see Abstr. 350 of 1956). The design procedure for fast wave couplers is given in detail in a separate section. The coupler consists of a Kompfner dip helix preceded and followed by a velocity jump. By this technique it is shown that a fast space-charge wave can be excited on the beam. The fast mode noise can be completely removed from the beam by the same coupler. The slow mode goes through completely unaffected in amplitude. Since the slow mode is not amplified, noise from the slow mode should not prove serious.

621.375.9 : 621.385.6

2355 THE QUADRUPOLE AMPLIFIER, A LOW-NOISE PARAMETRIC DEVICE.

R.Adler, G.Hrbek and G.Wade.

Proc. Inst. Radio Engrs, Vol. 47, No. 10, 1713-23 (Oct., 1959).

Unusually low noise, combined with high stable gain over fairly wide bands, has been obtained with electron beam amplifiers of a new kind. It is shown how this performance is achieved by the action of a transverse quadrupole field upon a fast cyclotron wave. The first two sections give a qualitative description of the device and of the amplifying mechanism. A physical description of the fast cyclotron wave is used to explain the interchange of signal and noise in the input coupler and the mechanism of parametric amplification in the quadrupole region. The third section presents a detailed analysis of the amplification process. It shows that the fast cyclotron wave is amplified in accordance with a cosh function of distance travelled through the quadrupole, and that a new cyclotron wave at idler frequency (difference between pump and signal frequencies) is generated which grows as a sinh function of distance. The fourth section describes experimental tubes built to date. These operate on frequency bands between 400 and 800 Mc/s. Typical bandwidth is 40 to 50 Mc/s, independent of gain, which may be adjusted to 20 or 50 db. Residual noise temperature of the electron beam in good specimens within this experimental lot is 70° K; input coupler loss raises this figure to about 100° K. This is equivalent to a noise figure of 1.4 db if the device is used, for instance, in radio astronomy. As with other parametric devices, a correction must be added in many other applications; its amount depends on the specific arrangement. This is explained in some detail in the fourth section. The last section attempts to state precisely the concepts on which the quadrupole amplifier is based and which distinguish it from conventional devices. These concepts may generate a variety of new tube structures in addition to the one described.

621.375.9

2356 THE NOISE AND GAIN PROPERTIES OF MOLECULAR AND PARAMETRIC AMPLIFIERS. E.D.Farmer.

J. Electronics and Control, Vol. 7, No. 3, 214-32 (Sept., 1959).

The noise and gain properties of a cavity amplifier are analysed with sufficient generality so as to include both the maser (molecular amplifier) and the parametric amplifier as special cases. This unification is achieved with the aid of the concepts of negative noise temperature and negative quality factor. These quantities are introduced by analysing the energy exchange between a general sample of matter and a quantized cavity field. This analysis shows that the presence of a sample in a cavity is formally equivalent to an additional cavity arm with a noisy load. Thus a unity of algebra is achieved and well-known cavity relations are used to derive the performance of a general one-port cavity amplifier. In particular the three-level maser of Bloembergen and the ferrimagnetic amplifier of Suhl are discussed in some detail. In conclusion it is shown that the results may be used to design an amplifier having optimum low-noise performance.

MODULATION . DEMODULATION

621.376.22

2357 STEADY-STATE ANALYSIS OF CIRCUITS CONTAINING A PERIODICALLY OPERATED SWITCH. A.Fettweis.

I.R.E. Trans Circuit Theory, Vol. CT-6, No. 3, 252-60 (Sept., 1959).

The exact conversion functions are calculated for networks containing one periodically operated switch, using familiar pole–zero and Fourier methods of analysis. It is first assumed that the switch is alternately open and closed during equally long time intervals. Circuits whose driving-point impedance Z(p) seen from the switch has neither pole nor zero at infinity are treated in detail. The analysis is then extended in order to allow for impedances Z(p) having either a pole or a zero at $p = \infty$. Complete results are also given for circuits whose switch is alternately open during time intervals of duration, T_1, and closed during intervals of duration, $T_2 \neq T_1$. The general analysis is applied to a series modulator and the realization of a given function of frequency as conversion function of such a modulator is investigated. The impedance Z(p) is assumed throughout to have only simple poles and simple zeros.

621.376.23

2358 OPTIMUM DETECTION IN THE PRESENCE OF CORRELATED NOISE. V.D.Zubakov.

Radiotekhnika i Elektronika, Vol. 3, No. 12, 1441-50 (1958). In Russian.

The theory of optimum detection of radar signals in the presence of correlated normal noise (receiver noise and noise due to reflection from randomly distributed objects) is given. The cases are considered of the detection of a completely known signal, a signal with unknown high-frequency phase and signal pulses with unknown random phases. [English summary: PB141106T-11, obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.]. R.C.Glass

621.376.23

2359 AN EXPERIMENTAL STUDY OF DETECTION IN NONSTATIONARY NOISE. T.R.Williams and J.B.Thomas.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 678-82 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

The performance of a detector operating with nonstationary noise has been studied experimentally, and some of the important effects of such noise on performance have been demonstrated. For long averaging times the results obtained are consistent with theory. While only one class of nonstationary noise was employed in the measurements, it is reasonable to expect that the behaviour of the detection system used will exhibit the same general characteristics for nonstationary noise having more complex low-frequency modulation envelopes. For moderate and high degrees of nonstationarity there will be regions where the threshold signal level will increase with increasing averaging time, and in such cases limiting or clipping prior to detection will result in lowered threshold signal levels. S.C.Dunn

621.376.232.2

2360 THE SINGLE-ENDED DIODE PHASE-SENSITIVE DETECTOR. R.Chidambaram and S.Krishnan.

Electronic Engng, Vol. 32, 158-9 (March, 1960).

The operation of the single-ended diode phase-sensitive detector with load is investigated. As in the case of the simple push-pull detector, the transfer ratios for the two diodes are found to vary considerably with the signal. This introduces a non-linearity in the output, which is evaluated, and a table is given from which the performance of a given detector of this type may be judged immediately. A comparison is made between this detector and the simple push-pull detector, and the loading conditions, under which one is superior to the other from the point of view of linearity, are discussed.

621.376.3

2361 MODULATION DISTORTION IN FREQUENCY MODULATION WITH PARTICULAR METHODS OF FREQUENCY BAND LIMITATION. E.Henze.

Ach. elekt. Übertragung, Vol. 13, No. 8, 348-55 (Aug., 1959). In German.

Expressions are deduced for the amount of distortion caused by a tandem-connected arrangement of critically-coupled double-tuned band filters. Results are given for two, three or four filters. V.G.Welsby

621.376.3

2362 NEW DEVELOPMENTS IN F.M. RECEPTION AND THEIR APPLICATION TO THE REALIZATION OF A SYSTEM OF "POWER-DIVISION" MULTIPLEXING. E.J.Baghdady.

I.R.E. Trans Commun. Syst., Vol. CS-7, No. 3, 147-61 (Sept., 1959).

Two techniques—feedforward across a limiter and dynamic trapping—are described to show how the message carried by the weaker of two cochannel f.m. signals can be extracted with negligible distortion even when its amplitude is much smaller than that of the stronger signal. Technique removes the stronger-signal capture limitation of f.m. systems and makes possible more efficient spectrum utilization.

621.376.32

2363 WIDEBAND F.-M. WITH CAPACITANCE DIODES. C.Arsem.

Electronics, Vol. 32, No. 49, 112-13 (Dec. 4, 1959).

The modulation is effected by variation of the capacitance of a semiconductor diode by a varying reverse voltage. Circuits are given for a 100 Mc/s Hartley oscillator using two diodes back-to-back and a 400 Mc/s Colpitts oscillator using a symmetrical transistor as modulator with the audio signal applied to the base.

W.G.Stripp

621.376.4

2364 APERIODIC PHASE DISCRIMINATOR. Yu.M.Bruk.

Radiotekhnika, Vol. 14, No. 10, 42-8 (Oct., 1959). In Russian.

A novel versatile phase discriminator is described, consisting of three triodes; it is capable of adding and subtracting two potentials in the frequency range from 1 to 10^5 c/s; operating as a phase detector; acting, if fed from a stabilized supply, as a d.c. comparator; capable of pulse waveform synthesis. The first two triodes are operated as a long-tailed push-pull pair, with symmetrical anode loads which join into a third common load, which is also the anode load of the third triode. The two inputs are applied to the grids of the first and third triodes, that of the second being grounded, and the two outputs are taken from the anodes of the push-pull pair (i.e. first and second tubes). An algebraic analysis of the operation of the discriminator is given, with formulae being derived for output voltages, internal impedances and gain in terms of μ and the four resistances. The paraphase pair is considered to have both equal and also widely differing μ values. The discussion covers a simple frequency correction method so as to extend the frequency range; brief indications of how to design for optimal operation with varying operational conditions are also given.

A.Landman

ELECTRONICS

SEMICONDUCTOR MATERIALS AND DEVICES
TRANSISTORS

621.315.59

2365 GAS-PHASE DOPING OF SILICON. J.Goorissen and A.M.J.G.van Run.

Proc. Instn Elect. Engrs, Paper 3022 E. [International Convention on Transistors and Associated Semiconductor Devices], Vol. 106B, Suppl. 17, 858-60, 883-4 (1959).

Single crystals of silicon doped with phosphorous and with a constant resistivity are prepared using a gas-phase doping technique. A constant flux of phosphorus atoms from the gas-phase via the liquid into the solid is created by decomposing phosphine in the vicinity of the floating liquid zone. Experimental details and a discussion of the results obtained with phosphine are given.

621.382

2366 PROPERTIES AND APPLICATIONS OF SOME BINARY AND TERNARY SEMI-CONDUCTING COMPOUNDS. H.Welker and R.Grehmelmaier.

Proc. Instn Elect. Engrs, Paper 3086 E [Lecture delivered at The International Convention on Transistors and Associated Semiconductor Devices] Vol. 106 B, Suppl. 17, 850-3, 883-4 (1959).

The binary III-V compounds are attractive for use in semiconductor devices because of their high electron mobility and large energy gap. Four methods have been used for the production of p–n junctions in these materials : pulling from the melt, diffusion, alloying and electroplating. Examples and characteristics are given of p–n junctions prepared by these techniques. The applications of these materials are discussed, and a short table is given of their solid solutions which form ternary and higher systems.

J.B.Birks

621.382 : 621.365.9 : 548.5

2367 THE GROWING OF 5 kg SINGLE CRYSTALS OF GERMANIUM. J.G.Wilkes.

Proc. Instn Elect. Engrs, Paper 2934 E, publ. May, 1959 [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 866-70, 883-4 (1959).

Republication, with discussion of the paper abstracted in Abstr. 3965 (1959).

621.382

2368 AN INVESTIGATION OF THE MANUFACTURE OF GERMANIUM SINGLE-CRYSTAL INGOTS BY THE LEVELLING PROCESS. N.G.Anderson and D.Gray.

Proc. Instn Elect. Engrs, Paper 3076 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 871-8, 883-4 (1959).

The factors influencing the crystal perfection and resistivity spread of ingots made by levelling have been examined theoretically and an attempt has been made to apply the conclusions drawn to the design of levelling equipment and the choice of process variables. The results have indicated that a low thermal gradient at the growing solid/liquid interface and high growth velocity are desirable from the point of view of crystal quality. However, the existence of such a low thermal gradient has an adverse influence on cross-sectional resistivity variations as a result, it is thought, of a micro-refining process It is concluded that improved crystal quality with good control of cross-sectional resistivity distribution can only be achieved by improved temperature control.

621.382

2369 THE PRODUCTION AND EVALUATION OF SEMICONDUCTOR-GRADE SILICON. V.Magee.

Proc. Instn Elect. Engrs, Paper 3091 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, 879-82, 883-4 (1959).

An account is given of the main principles and problems encountered by the device manufacturer in the utilization of semiconductor-grade silicon. The general types of reaction described are illustrated by an account of their application in some research done on the production of silicon in bars $\frac{1}{2}$ in. diameter, and 2 ft long. The chemical route involved is the reduction of silicon tetrachloride with hydrogen. The properties of the product obtained are described. The major importance of producing silicon in bar form suitable for zone refining, using the floating-zone technique, is described in its relation to the question of crucible contamination factors applying to conventional silicon single-crystal techniques. The development of a simplified form of floating-zone refining apparatus is described, together with experience gained in producing single crystals in the apparatus using various forms of silicon, including that produced in a bar silicon plant. In conclusion, an outline is given of some views held on the evaluation of silicon raw material. The main theme is that the most satisfactory trial at present is the production of single crystals in a standard manner and the conduction of observations of resistivity lifetime, conductivity type and high-voltage rectifier yield obtained in a "diffusion" rectifier manufacturing line.

621.382

2370 THE RECOMBINATION OF EXCESS CARRIERS AT A SILICON–ELECTROLYTE INTERFACE. H.U.Harten.

Proc. Instn Elect. Engrs, Paper 2877 E, publ. May, 1959 [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 906-7, 937-8 (1959).

Republication, with discussion, of the paper abstracted as Abstr. 2692 (1959).

621.382

2371 A REVIEW OF RECOMBINATION MECHANISMS IN SEMICONDUCTORS. P.T.Landsberg.

Proc. Instn Elect. Engrs, Paper 2964 E, publ. May, 1959 [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 908-14, 937-8 (1959).

Republication, with discussion, of the paper abstracted in Abstr. 3362 (1959).

621.382

2372 RECOMBINATION PROCESSES IN SEMICONDUCTORS. R.N.Hall.

Proc. Instn Elect. Engrs, Paper 3047 E [International Convention on Transistors and Associated Semiconductor Devices], Vol. 106B, Suppl. 17, 923-31, 937-8 (1959).

Recombination of electrons and holes may take place in the host

crystal or at impurity centres, the energy being removed by radiation of a light quantum, by multiphonon emission, or by an Auger process. The probabilities for each of these six processes are discussed. While the lifetime in semiconductors is usually determined by multiphonon recombination at impurity centres, Auger recombination in the host crystal can be expected to dominate in small-band-gap crystals containing large concentrations of free carriers. Radiative recombination in the host crystal may limit the lifetime in semiconductors where band-to-band transitions are direct, provided that the specimens are reasonably free of recombination centres.

621.382

2373 A RELIABILITY APPRAISAL OF SEMICONDUCTOR DEVICES. R.Brewer and W.W.D.Wyatt.

Proc. Instn Elect. Engrs, Paper 2980 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 951-7, 1009-11 (1959).

The current problems of assessing the reliability of semiconductor devices are discussed, and reference is made to the order of reliability required in typical applications. The evidence from life tests carried out on devices drawn from production lines of transistors and diodes shows how variations in operating conditions and assessment levels affect the apparent reliability of the devices. This type of appraisal gives a useful guide to the reliability of semiconductor devices in typical service use. The incidence of inoperative failures, the trends shown by measurements of major characteristics during life, and the form of life-survival curves are discussed, and a brief reference is made to the equipment used in carrying out the tests.

621.382

2374 ENVIRONMENTAL AND DEVICE CLEANNESS AND PURITY STANDARDS. J.F.Pudvin.

Proc. Instn Elect. Engrs, Paper 3094 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1125-9, 1153-4 (1959).

Semiconductor devices are particularly sensitive to surface contamination, and special methods are required to attain, test and maintain exceptionally clean surface conditions during device fabrication. Contaminants are classified into five types — physical, organic, ionic, chemically combined and gaseous — and each type is discussed in the following terms: nature of the contaminants; methods for removal or prevention: tests for degree of removal; evaluation of current process capabilities; and application to electronic devices. J.B.Birks

621.382

2375 SEMICONDUCTOR COMPONENTS. G.Markesjö and P.O.Leine.

Tekn. T., Vol. 20, No. 5, 81-93 (Jan. 29, 1960). In Swedish.

The basic mechanism of the transistor is explained with emphasis on its control characteristics. Its fundamental static equations are derived and with their aid equipment circuits of the double-diode, hybrid-π and T forms are developed. Limiting conditions of temperature, voltage and current are considered. More recent transistor designs are surveyed and an output–frequency chart is shown for the main types. A brief account is given of photo-transistors, negative-impedance components, controlled dry rectifiers, thyristors and the tunnel diode. G.N.J.Beck

621.382 : 621.317.79

A RESISTANCE-NETWORK ANALYSIS OF THE CURRENT GAIN OF JUNCTION TRANSISTORS. See Abstr. 2177

621.382 : 621.317.61

FURTHER CONSIDERATION OF BULK LIFETIME MEASUREMENT WITH A MICROWAVE ELECTRODELESS TECHNIQUE. See Abstr. 2152

621.382.2

2376 THE NESISTOR—A SEMICONDUCTOR NEGATIVE RESISTANCE DEVICE. R.G.Pohl.

I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 278-87 (July, 1959).

A semiconductor device similar in principle to the injecting-drain-field-effect transistor, having wide ranges of controllable negative resistance which can be used in counting, flip-flop, amplifying, and oscillator circuits, is described. The negative resistance arises from the modulation of the current between two ohmic contacts of circular symmetry, on a flat semiconductor wafer, by the effect of the collection of minority carriers on the pinching potential of a collector electrode. Families of negative resistance, of either the shunt or series type, are obtainable depending upon the mode of operation. Power gains of 60 dB and a thermal dissipation of 0.25 W have been achieved in liquid-cooled units the size of high-frequency transistors. An improved sandwich-type base tab for mounting semiconductor wafers is shown. A theoretical analysis of the operation of the device permits prediction of the effect of various physical parameters upon the static electrical characteristics.

621.382.2

2377 THERMALLY-INDUCED CRACKING IN THE FABRICATION OF SEMICONDUCTOR DEVICES. T.C.Taylor.

I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 299-310 (July, 1959).

The literature is reviewed. A model is developed to describe in qualitative terms, the stress distribution and mechanics of cracking; the significant variables of the cracking process are summarized. Remedial measures which have been proposed are discussed. An analytical model is given which describes the stress distribution in the chip of a semiconductor device, and predicts a location of maximum stress which is in agreement with experimental results. A formula is derived for the calculation of the maximum semiconductor tensile stress in an elastic model. The modifications required on the model in cases of inelastic behaviour are discussed. Three appendices are given: (1) experimental methods of crack detection; (2) analytical design methods for tabbed device structures; and (3) references for some structural properties of Ge and Si.

621.382.2

2378 SOME REACTIVE EFFECTS IN FORWARD BIASED JUNCTIONS. T.E.Firle and O.E.Hayes.

I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 330-4 (July, 1959).

The small-signal equivalent parallel capacitance of forward-biased semiconductor junctions is strongly dependent on the current. At very low currents (less than 10 μA for a junction area of 1 mm^2) the capacitance appears to be chiefly due to space-charge effects. For currents up to approximately 100 μA, it complies with Shockley's predicted low-level theory. For larger currents, however, there is a definite deviation from the low-level diffusion predominance and capacitance reaches a maximum after which it decreases through zero and then goes to large inductive values. The latter phenomena is explained, qualitatively, by considering an inductance in series with the diffusion capacitance. The capacitance increases linearly with current but the inductance (due to conductivity modulation) increases faster. The result is that a change from an equivalent RC circuit to an equivalent RL circuit is made at high enough currents (5 mA is a typical value for the 1 mm^2 junction area). Measurements were made on abrupt silicon junction diodes with junction areas of about 7×10^{-4}, 10^{-3}, 10^{-1} cm^2 and on the emitter junction (about 5×10^{-5} cm^2) of a diffused base silicon transistor.

621.382.2 : 681.142

2379 SEMICONDUCTOR PARAMETRIC DIODES IN MICROWAVE COMPUTERS. J.Hilibrand, C.W.Mueller, C.F.Stocker and R.D.Gold.

I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 287-97 (Sept., 1959).

The parametric subharmonic oscillator operates by energy transfer from the pump frequency to the oscillator frequency through a nonlinear energy storage element — in the present case, the nonlinear capacitance of a semiconductor diode. The requirements on the diode for satisfactory performance and the limitations on oscillator performance which arise from the nature of the diode are examined. The analysis shows that abrupt junction diodes must have a Q of at least four at the oscillation frequency if there is to be any useable energy transfer, and that graded junction diodes must have a Q of six. The time-constant governing the rise of the envelope of the subharmonic waveform is a marked function of the stray capacitances; this function is examined in detail. The choice of bias voltage to obtain the fastest possible rise time involves consideration of the stray capacitance, the Q of the available diode, and limitations imposed by excessive pump power requirements. For negligible stray capacitance, it is shown that the subharmonic waveform can rise by a factor e in 1.3 cycles of the subharmonic frequency for an abrupt junction diode, or in 1.9 cycles for a graded junction diode. The principles involved in the design of the semiconductor diode are examined and the choice of materials, impurity distributions, and fabrication techniques are discussed. A new diode encapsulation intended for direct mounting in microstrip

transmission line is described. An equivalent circuit characterization in which diode parameters may be directly related to diode structure is used. Several techniques for the measurement of these parameters are discussed.

621.382.22

2380 POINT-CONTACT DIODES IN TERMS OF p-n JUNCTION THEORY. R.E.Nelson.

I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 270-7 (July, 1959).

A "formed" n-type germanium point-contact diode is qualitatively reminiscent of an idealized model that comprises an abrupt hemispherical p–n junction, both regions of which may have moderate resistivity, terminated on the inner (p) and outer (n) sides by hemispherical ohmic contacts. The extent to which this model can be justified quantitatively is investigated. Low-injection analyses of the static and small-signal, frequency-dependent properties suggest that the model is capable of predicting the corresponding experimentally observed behaviour. Consideration of space-charge-layer widening with reverse bias allows the computation of breakdown and punch-through voltages, which correspond in magnitude range to the observed peak inverse voltages of formed germanium point-contacts. A high-injection analysis of the static forward characteristics indicates approximate agreement between theory and experiment, even for the nonlinear spreading resistance.

621.382.23 : 621.319.43

2381 A DESIGN THEORY FOR THE HIGH-FREQUENCY p-n JUNCTION VARIABLE CAPACITOR. C.J.Spector.

I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 347-51 (July, 1959).

One of the more significant uses of the p-n junction variable capacitor is as an h.f. (> 100 Mc/s)tuning element. Structures which have been available have had rather low Q at these frequencies. In order to determine the limits imposed on Q by the physics of the device, a fundamental study was made. Equations were developed for the prediction of Q in alloyed and diffused structures. Optimization criteria are proposed which permit design of capacitors in which Q is no longer a significant limitation. In support of the theory, experimental results are presented on units designed and fabricated in accordance with the optimization criteria. Q's in excess of 500 have been observed at 100 Mc/s.

621.382.23

2382 ENVIRONMENTAL EFFECTS ON THE GROWTH OF EXCESS REVERSE CURRENT IN GERMANIUM P-N JUNCTIONS. J.I.Carasso.

Proc. Instn. Elect. Engrs, Paper 3080 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 964-7, 1009-11 (1959).

An experimental study is described of the effect of various forms of surface contamination upon the slow growth of excess reverse current in germanium p-n junctions ("creep effect").

621.382.23

2383 ESAKI TUNNELING. P.J.Price and J.M.Radcliffe.

I.B.M. J. Res. Develop., Vol. 3, No. 4, 364-370, 371 (Oct., 1959).

Tunnelling, between propagating electron states, at a semiconductor junction is discussed in terms of customary quantum transition theory for the matrix elements of the Hamiltonian between the states representing reflection of an electron (in either band) from the junction. The coordinate representation for the wavefunctions of these states is investigated, and tunnelling probabilities (ratios of transmitted to incident current) are found for the "elastic" process proposed by Esaki and for the "phonon-assisted" processes. It appears that the tunnelling may be described as taking place in a central region of the junction thinner than the space charge region. Current-voltage characteristics are calculated both for elastic and for phonon-assisted tunnelling.

621.382.23

2384 THE CHARACTERISTICS OF SILICON VOLTAGE-REFERENCE DIODES. A.E.Garside and P.Harvey.

Proc. Instn Elect. Engrs Paper 3055 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 982-90, 1009-11 (1959).

Two theories of breakdown mechanism in silicon junction diodes have at present been advanced, avalanche and field emission, one by Zener and the other by Von Hippel and Frühlich. At various times physicists have supported one or the other of these theories operating independently, but the development of the low-voltage silicon reference diode has indicated that the two methods of breakdown can occur simultaneously. An explanation of the peculiar behaviour of the voltage/temperature coefficient of such diodes can be made by incorporating both breakdown mechanisms. It is shown that very-close-tolerance devices must be used in experimental work. Comparison of the breakdown with experimental results shows that the breakdown of diodes at voltages less than 4.5 volts is due to field emission, greater than 6.5 volts is due to avalanche effects, and between 4.5 and 6.5 volts is due to a combination of both effects. Confirmation of these results is made by noise measurements. A characteristic surface of temperature coefficient of breakdown voltage shows skew properties which suggests that a diode having zero temperature coefficient over a wide range cannot exist for the currents and voltages considered.

621.382.23

2385 THE EFFECT OF RECOMBINATION AT THE NON-RECTIFYING ELECTRODE ON THE CHARACTERISTICS OF ALLOYED GERMANIUM DIODES.

N.A.Penin and K.V.Cherkas.

Radiotekhnika i Elektronika, Vol. 3, No. 12, 1495-500 (1958). In Russian.

The effect of recombination velocity at the second (non-rectifying) electrode on the characteristics of alloyed Ge–Jn diodes with various base thicknesses is investigated. It is found that increase in recombination velocity in diodes with thin base reduces the frequency dependence of diode capacitance and resistance, reduces the magnitude of diffusion capacitance and increases the saturation current. The recombination velocity is derived for copper and tin electrodes. [English summary: PB 141106T-11, obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.]. R.C.Glass

621.382.3

2386 THE PHYSICAL INTERPRETATION OF MEASUREMENTS ON TRANSISTORS. S.Deb and A.N.Daw.

J. Electronics and Control, Vol. 6, No. 6, 552-3 (June, 1959).

Points out that, for the conditions actually used in the measurements reported earlier (Abstr. 1009 of 1959), the errors in lifetime due to the neglect of the terms in C_e are only of the order of 2%. F.F.Roberts

621.382.3 : 621.385.1

2387 A MODERN APPROACH TO SEMICONDUCTOR AND VACUUM DEVICE THEORY. R.D.Middlebrook.

Proc. Instn Elect. Engrs, Paper 3180 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, 887-902, 937-8 (1959).

An integrated approach to the understanding of charge-controlled electronic devices is presented. Although only vacuum triodes and diffusion-type transistors are discussed in detail, the methods suggested are also applicable to gas-filled and multi-electrode vacuum structures, to surface-barrier and to drift-type transistors, and to space-charge-limited solid-state devices. The treatment is tutorial in nature, and begins with the development of general equations of current flow applicable in any medium. The principles of charge-controlled devices are then summarized, and a general functional relationship between the total charge in transit and the transit time is developed. These results are then applied in turn to vacuum and semiconductor diodes and triodes to derive in a remarkably simple and consistent manner the salient features of their operation. "Ideal" vacuum triode and transistor structures are first discussed, and the voltage and current amplification factors are then introduced as arbitrary parameters to account for practical departures from ideality. Specific results obtained are the d.c. characteristics and incremental equivalent circuits for each device. The model established for the transistor is identical with the hybrid-π circuit due to Giacoletto, and both low- and high-level injection conditions are included. Finally, it is suggested that the transistor collector saturation current with open base is a more fundamental quantity than that with open emitter, and the temperature dependence of the base-emitter voltage is shown to be linear at any injection level. Throughout, emphasis is on the principles involved and on the method of approach, and a particular effort is made to present the development of the vacuum and the semiconductor devices in a completely analogous manner.

621.382.3

2388 THE DEPENDENCE OF CURRENT AMPLIFICATION ON TRANSISTOR GEOMETRY AND MINORITY-CARRIER LIFETIME. G.Roman.

Proc. Instn Elect. Engrs, Paper 3164 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B,

Suppl. 18, 932-6, 937-8 (1960).

Seeks the approximate functional relationship between current amplification factor, α, base width, w, and effective lifetime, τ, of minority carriers in the base region of a transistor. In any set of observations this functional relationship may be obscured by variations in other parameters, so that statistical techniques must be used to eliminate their influence. The numerical calculations are based on the relationships

$$\alpha = \alpha_o - g(\tau, w) = \alpha_o - h(\tau, f_{\alpha d}) = \alpha_o - f(\tau)w^{\sigma}$$

where g, h and f are functions of the effective lifetimes in the base region. The data to determine $h(\tau, f_{\alpha d})$ were obtained from the curves of best fit to the scatter diagrams of α against $1/\tau$ with $f_{\alpha c_o}$ constant. For the typical r.f. transistor under consideration the general relationship

$$\alpha = \alpha_o - 0.21/f_{\alpha d}0.9\tau$$

was obtained; this is basically in agreement with that developed by Stripp and Moore. The statistical method involved and its application to the particular problem is examined. The measuring techniques are discussed in the light of possible errors and their compensation, and formulae are derived for σ and $f(\tau)$. The probable causes of the statistical spreads observed are reviewed and the results obtained are compared with the findings of Stripp and Moore.

621.382.3

2389 THE INITIAL REGION OF THE CHARACTERISTICS OF A TRANSISTOR IN THE COMMON-EMITTER CONNECTION. K.H.Ginsbach.

Proc. Instn. Elect. Engrs, Paper 3043 E [International Convention on Transistors and Associated Semicomductor Devices] Vol. 106B, Suppl. 17, 991-7, 1009-11 (1959).

The emitter-base forward characteristic with the collector at base potential is given as the physical boundary line of the initial region of the collector and emitter characteristics, respectively, in the common emitter circuit. Using two examples, the formation of the initial region of the emitter and collector characteristics, respectively, of constant input voltage is examined and explained. The emitter-current/collector-voltage curve at constant input voltage is discussed. The rise of emitter current at constant input voltage is explained by a decrease in input resistance, caused by the collector-base forward current. The decrease of emitter current in the region of small collector voltages arises from the increase in the charge carrier concentrations at the collector junction, by which the gradient of the charge carriers between emitter and collector is smoothed and thus the current is decreased. To explain the collector characteristics a current distribution factor A^x is defined in the initial region, the value of which is in approximate agreement with the current gain A beyond the inital region. With the current distribution factor so defined and using the collector-base forward characteristics, we can construct, with the aid of the emitter characteristics, a family of collector characteristics which, within the range of the accuracy of measurement, corresponds to the measured values. The dependence of the envelopes limiting the collector characteristics to small collector voltages and of the collector voltage, whose collector current is zero, upon the geometry of the transistor is explained. A simple construction of the envelope is shown. Steep envelopes and small collector voltages for $I_c = 0$ may be obtained by means of a high current gain, a small distance between base and emitter and as little overlapping of the projections of base and collector as possible.

621.382.3

2390 TRANSISTOR EQUIVALENT CIRCUITS. R.L.Pritchard.

Proc. Instn Elect. Engrs Paper 3097 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1012-17, 1072-4 (1959).

The literature on junction transistors contains a number of papers on equivalent circuits, and in general these fall into one of two categories: the equivalent circuits may be based either on a physical model for the device, or on a 2-port network representation. The usual simplified model of a transistor is reviewed briefly, together with the equivalent circuits in common use. The limitations of these circuits are discussed. Finally, several modifications are presented which are more applicable for many of the newer high-frequency transistors, especially of the mesa-type construction.

621.382.3 : 621.317.61

2391 THE EFFECT OF CARRIER STORAGE IN THE EMITTER ON TRANSISTOR INPUT ADMITTANCE. J.J.Sparkes.

Proc. Instn Elect. Engrs, Paper 3007 [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1102-7, 1119-21 (1959).

A variation with frequency of $C_{b'e}$ and $g_{b'e}$ in the hybrid-π common-emitter equivalent circuit, which differs from that predicted by Giacoletto, is reported. It is found that the effect is present in a significant proportion of, but not in all, junction transistors. The phenomenon is explained in terms of minority-carrier storage in the emitter region or in terms of extra minority-carrier storage in the base, and experimental measurements which correlate well with theory are presented. It is pointed out, first, that $C_{b'e}$ at low frequencies may be more than double its value at the cut-off frequency, so that calculation of $C_{b'e}$ from the value of the cut-off frequency may be seriously in error, and secondly that, since emitter storage may be the dominant effect in determining cut-off frequency, it is expected that, in general, the cut-off frequency is less than $2D/w^2$.

621.382.3

2392 EFFECT OF DEVICE DESIGN ON PERFORMANCE AND QUALITY. J.C.Van Vessem.

Proc. Instn Elect. Engrs, Paper 3096 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1122-4, 1153-4 (1959).

The performance of a semiconductor device depends mainly on its physical and geometrical structure. Its quality depends more on surface condition and on encapsulation. The relation of these factors to design, and to cost and yield, are discussed in a general manner.

J.B.Birks

621.382.3

2393 RELIABILITY OF TRANSISTORS. T.G.Charles and D.Hartman.

Tekn. T., Vol. 90, No. 5, 119-24 (Jan. 29, 1960). In Swedish.

In manufacturer's tests 20 transistors per week of each type are submitted to a 10^4 hr life tests at an ambient temperature of 45°C with the transistors electrically loaded to produce a crystal temperature of 75°C. D.C. amplification behaviour after life test is shown for 3 types of transistor. One test consists in the oscillographic measurement of collector and emitter leakage currents, d.c. amplification factor and collector–emitter voltage. Failure statistics based on data supplied by manufacturers and users are shown plotted as percentage/1000 hr against crystal temperature. The mean curve drawn is flat below 40°, above which it rises steeply. A report on an enquiry into transistor reliability conducted among a number of large Swedish users is summarized. G.N.J.Beck

621.382.3

2394 IMPROVED CONTROL OF CRITICAL DIMENSIONS IN TRANSISTOR MANUFACTURE. N.J.Crocker.

Siemens Edison Swan J., Vol. 1, 169-73 (Autumn, 1959).

A new approach is made to the accurate control of those dimensions which are most critical in transistor manufacture. This involves the use of accurately worked rubies, and a short account is given of the development of the ruby hole, firstly for the watch industry, and later for use in transistor alloying jigs. A section then outlines the final design of ruby jigs, followed by a comparison of the physical dimensions and electrical characteristics of transistors made by these jigs and by more conventional techniques.

621.382.3 : 621.374.32

TRANSISTOR SWITCHING SPEED.
See Abstr. 2312

621.382.3 : 621.317.61

DETERMINATION OF PHYSICAL PARAMETERS AND GEOMETRY OF A JUNCTION TRANSISTOR. See Abstr. 2155

621.382.3.012.8

2395 SOME ASPECTS OF SMALL-SIGNAL HIGH-FREQUENCY EQUIVALENT CIRCUITS FOR TRANSISTORS. L.G.Cripps.

Proc. Instn Elect. Engrs Paper 3009 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106 B, Suppl. 17, 1026-32, 1072-4 (1959).

Equivalent circuits for transistors are extremely useful tools in circuit design. There are, however, certain dangers associated with

their use, resulting from the approximations which are usually inherent in their derivation. These dangers are discussed, using current gain and high-frequency output admittance to illustrate the problems.

621.382.332

2396 AN R.F. POWER TRANSISTOR.
J.E.Iwersen and J.T.Nelson.
Bell Lab. Record, Vol. 37, No. 10, 390-3 (Oct., 1959).

Outlines the development of a Si transistor for 5 W output at 10 Mc/s (unity current-gain 80-120 Mc/s), peak common-emitter operating voltage 100 V and maximum collector current of over 400 mA. The structure uses an emitter stripe 0.060 in. long by 0.008 in. wide, a diffused base layer 0.00006 in. thick, a diffused collector region and an intrinsic collector barrier region 0.0004 in. thick. F.F.Roberts

621.382.333

2397 GERMANIUM PNPN THYRATRON.
M.Klein and A.P.Kordalewski.
I.B.M. J. Res. Developm., Vol. 3, No. 4, 377-9 (Oct., 1959).

Describes a unit having a breakover voltage of 70-100, a minimum sustaining current of 10 μA, a switching speed of 0.2 μsec, and an ability to pass 300 mA at a voltage drop of 0.5 V. The component alphas are both low but their sum exceeds unity at all forward currents, so that the device must be held in the "off" state by reverse bias of a few tenths of a volt on the control electrode. F.F.Roberts

621.382.333

2398 TRANSISTOR NOISE FACTOR CALCULATIONS.
F.Hibberd.
Electronic Engng, Vol. 32, 163-4 (March, 1960).

A method of estimating transistor noise factors is given; it is based on the use of four noise parameters, which are expressed in terms of the transistor equivalent circuit parameters. A general expression for the minimum noise factor is derived, which can be simplified according to circumstances.

621.382.333

2399 MEDIUM POWER HIGH-SPEED GERMANIUM ALLOY TRANSISTORS.
H.E.Hughes, T.R Robillard and R.W.Westberg.
I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 311-14 (July, 1959).

Units have been designed and produced which exhibit a median cutoff frequency of 7 Mc/s and a punch-through voltage of 70 V. High production rates were achieved by very close manufacturing controls of the critical alloying variables, namely, germanium wafer thickness, alloyed junction area, concentricity, mass alloying material, alloying temperature, and special material properties such as orientation and etch-pit density. A vacuum-tight transistor structure has been designed to permit the dissipation of 0.5 W at 25°C in free air. The structure embodies an all-copper cold-welded encapsulation for efficient heat removal. Techniques concerning the cold-welding process are discussed, and the particular die contour used is illustrated in some detail. Additional cleanliness advantages are obtained by use of the cold-welded seal.

621.382.333

2400 MAXIMUM RAPIDLY-SWITCHABLE POWER DENSITY IN JUNCTION TRIODES. J.M.Early.
I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 322-5 (July, 1959).

The maximum power density which may be switched at (switching time/current gain) quotients comparable to $1/2\pi f_\alpha$ is shown to be $10^9 - 4 \times 10^9$ W/cm^3 for p–n–p Ge transistors. This result is derived first for junction triodes in which the collector depletion layer at peak reverse voltage lies largely in a collector body of conductivity type opposite to that of the base; e.g. diffused-base transistors of the mesa type. The limitation arises from the linear dependence of maximum (scattering limited) current density (J_{max}) on collector-body impurity concentration (N_Ac) and from the approximately reciprocal dependence of breakdown voltage (BV_{CB}) on the same parameter. It is shown that space-charge limitation of current density leads to a somewhat lower limit for intrinsic collector barriers of the same maximum width and, a fortiori, to a lower value for collector barriers lying largely in material of the same conductivity type as the base layer. Similar limits for n–p–n Ge and for Si transistors are higher but generally comparable.

621.382.333

2401 TRANSISTOR EQUIVALENT CIRCUIT MODIFICATION DUE TO NON-EQUIPOTENTIAL BASE.
L.J.Giacoletto.
J. Electronics and Control, Vol. 7, No. 3, 233-42 (Sept., 1959).

Shockley obtained simple and useful results for transistor parameters by assuming that the base region of a transistor is equipotential. This assumption is generally not valid even at small currents since a minority carrier density gradient must be accompanied by a voltage gradient. The effects of the voltage through the base can be accommodated by introducing a resistance into the equivalent circuit. A formula for this resistance is derived and the consequences of its presence are studied in relation to prior measurements.

621.382.333

2402 AN ACCELERATED AGEING EXPERIMENT ON GERMANIUM p–n–p ALLOY TYPE TRANSISTORS.
F.F.Roberts, J.C.Henderson and R.A.Hastie.
Proc. Instn Elect. Engrs, Paper 3008 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 958-63, 1009-11 (1959).

A total of 660 transistors, purchased to a specification involving 100% initial testing, including damp heat cycling, have been placed on life test in groups with junction temperatures at 50, 60, 70, 80, 90 and 100°C, with power dissipations such as to give junction temperature rises of 0, 10 or 20°C above the temperature of the mounting, and with collector voltages of 0, −1, −4 and some −20 V. From the data so far accumulated and analysed it appears that most of the units will end their lives owing to excessive rise of collector leakage current, that there is no significant correlation between life and initial value of collector leakage current, and that positive correlation exists between deterioration of noise figure at 1 kc/s and deterioration of noise figure at 1 kc/s and deterioration of leakage current, the deterioration being markedly more common for units aged at the higher voltages.

621.382.333

2403 THE MAXIMUM VOLTAGE, CURRENT AND POWER RATINGS OF JUNCTION TRANSISTORS.
R.A.Hilbourne and D.D.Jones.
Proc. Instn Elect. Engrs, Paper 3048 E [International Convention on Transistors and Associated Semiconductor Devices], Vol. 106B, Suppl. 17, 998-1003, 1009-11 (1959).

Discusses the properties of a junction transistor which determine the limits of the three basic ratings, namely the maximum collector voltage, collector current and power dissipation, and describes methods of measurement. The effects of the limitations on the various circuit configurations are also discussed. The maximum value of both the direct and alternating voltages that may be applied to a transistor are dependent upon the variation of the characteristics with voltage. The most important of these factors are surface leakage, avalanche multiplication and collector/emitter punch-through. The last is an absolute limitation whereas the first two result in a variation of the current gain and output impedance. The effects of these variations are very dependent upon the circuit arrangement and the possible parameter tolerances. The collector leakage current can also result in thermal instability. In general the important value of the leakage current, from the circuit-performance aspect, is that at high temperature. However, to simplify measuring and for life considerations, a low-temperature test may be more suitable. The maximum current rating is normally determined by the decrease in current gain at high emitter currents. Again this limitation is dependent upon the circuit arrangement and it is not possible to set an absolute limit. For linear-amplifier applications the variation of current gain with emitter current should be low, whereas, in switching applications, only the gain at high current is of importance. The power dissipation rating of a transistor is basically determined by the effect of a high internal temperature on its life. However, a convenient method of expressing the rating, as a function of ambient temperature, is by means of a maximum junction temperature and a thermal resistance. Since the total thermal resistance is dependent upon the mounting arrangements, the user must consider both the electrical and thermal properties of any transistor circuit. The transient power rating of a transistor is also of importance in many switching circuits.

621.382.333

2404 THE CURRENT GAINS OF DIFFUSION AND DRIFT TYPES OF JUNCTION TRANSISTORS. F.J.Hyde.

Proc. Instn Elect. Engrs, Paper 2937 E, publ. May, 1959 [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1046-55, 1072-4 (1959).

Republication, with discussion, of the paper abstracted in Abstract 3027 (1959).

621.382.333

2405 TRANSIENT RESPONSE OF JUNCTION TRANSISTORS AND ITS GRAPHICAL REPRESENTATION.

A.Kruithof.

Proc. Instn Elect. Engrs, Paper 3003 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, 1092-1107, 1119-21 (1959).

After a discussion of the nature of the transitions taking place when a junction transistor is switched from one working point to another, diagrams are presented which illustrate the transient response in the common-base and common-emitter configurations for both the normal and the saturation regions.

621.382.333

2406 DYNAMIC PROPERTIES OF JUNCTION TRANSISTORS IN PULSE OPERATION. J.Budínský.

Slaboproudy Obzor, Vol. 20, No. 12, 747-53 (1959). In Czech.

It is pointed out that in pulse operation, the output pulse of a junction transistor is characterized by a rise time T_n, a delay (or storage) time T_z and a decay time T_d. These can be determined, for the three basic transistor connections, on the basis of the Ebers–Moll equations (see Abstr. 937 of 1955). The times can thus be expressed in terms of the r.f. parameters and peak currents of the transistor. It is possible to regard the transistor as a charge-controlled device; in this case the switching properties of the transistor can be specified by a set of time constants, as defined by Beaufoy and Sparkes (see Abstr. 866 of 1958). The constants can be determined experimentally without great difficulty. The methods of reducing T_z in transistor switching circuits are briefly discussed.

621.382.333 : 621.373.44

AVALANCHE TRANSISTORS AS FAST PULSE GENERATORS.

See Abstr. 2267

621.382.333.3

2407 TRANSISTOR AVALANCHE VOLTAGE. L. van Biljon.

Electronic Technol., Vol. 37, No.2, 72-6 (Feb., 1960).

An expression giving the collector avalanche voltage in an alloyed junction transistor as a function of base resistance is developed from simple considerations of transistor currents. It is indicated how this expression may be used to predict the voltage where avalanche breakdown will set in for any value of base resistance, once the breakdown voltage at a particular value of base resistance, including $R_b = 0$ and $R_b = \infty$, is known. It is furthermore shown that the avalanche voltage is a function of both forward- and reverse-current amplification factors but that, at high values of base resistance, the reverse amplification factor is not important. It is concluded from experiment that it is not the base resistance itself which determines the avalanche voltage but rather the emitter–base voltage as set up by the current through this resistance.

621.382.333.3

2408 TRANSISTOR SWITCHING-CIRCUIT DESIGN USING THE CHARGE-CONTROL PARAMETERS. R.Beaufoy.

Proc. Instn Elect. Engrs, Paper 2970 E, publ. May, 1959 [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1085-91, 1119-21 (1959).

Republication, with discussion, of the paper abstracted in Abstr. 3686 (1959).

621.382.333.33

2409 TRANSIENT AND PHASE–FREQUENCY CHARACTERISTICS OF CURRENT GAIN OF DRIFT TRANSISTORS. T.M.Agakhanyan.

Radiotekhnika, Vol. 14, No. 12, 38-43 (Dec., 1959). In Russian.

A general discussion of the basic physical parameters of drift transistors is presented, following closely the well-known investigations by Krömer and Early. Relationships between minority carrier lifetime and mobility, diffusion coefficient (mainly dependent on base dimensions), emitter efficiency and field potential are explained, and formulae for α and β as functions of ω are derived in above terms under consideration of impurity concentration in emitter and collector junctions (N_e and N_c), expressed by the diffusion change rate in the base ($\eta = \frac{1}{2} \ln N_e/N_c$). The transient response characteristics are derived by permissible simplification of these formulae, e.g. by neglecting the change of injection efficiency with frequency, typical responses being plotted with η as parameter. The calculation of phase angle is shown to be quicker than measurement and to be accurate for most purposes; thus for a change of N_e/N_c of 100 to 200 the phase-shift coefficient — $(0.21 + 0.3\ \eta)$ — alters from 0.90 to 1.05 only. A.Landman

621.382.333.33.012.8

2410 AN ANALOGUE OF A DIFFUSED-BASE TRANSISTOR. J.A.G.Slatter.

Proc. Instn Elect. Engrs, Paper 3101 E [International Convention on Transistors and Associated Semiconductor Devices] Vol. 106B, Suppl. 17, 1067-71, 1072-4 (1959).

The design and construction of an analogue to represent the small-signal response of a transistor with a constant field in its base is described and the accuracy with which the analogue approximates to the transistor is given.

PHOTOELECTRIC DEVICES

621.383

2411 A ONE-WATT SOLAR POWER PLANT. D.H.Smith.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 530-5 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Reports on construction and operation of a solar power unit operated on silicon photodiodes having individual open-circuit characteristic of about 0.5 V in sunlight with a short-circuit current of 0.1 A. Forty-eight 9-cell diode units were mounted in transparent plastic cases filled with silicone oil to reduce refraction losses and connected to give peak output of 0.5 A at 22 V to charge a 22 V 15 Ahr sealed nickel-cadmium battery. Field tests demonstrated the feasibility of continuous operation at one watt. R.W.J.Cockram

621.383.2 : 537.533

2412 THE THERMOEMISSION AND PHOTOEMISSION MAXIMA IN SILVER–CAESIUM PHOTOCATHODES. M.Partlová and L.Eckertová.

Czech. J. Phys., Vol. 9, No. 2, 263-5 (1959). In Russian.

From experiments on processing Ag-Cs photocathodes, it is found that the thermionic and photoemission current maxima need not necessarily occur simultaneously in activation. The highest integral sensitivity will only be obtained when the lowest work function occurs simultaneously with the formation of an optimum inner photocathode structure, and the conditions for this are considered to be difficult to attain in practice. It is recommended therefore, in the activation of photocathodes of high integral sensitivity, to monitor the photocurrent (instead of the thermionic current) and also the spectral characteristic. V.V.Zakharov

621.383.2

2413 RADIATION, FIELDS, AND ELECTROLUMINESCENT PHOSPHORS. W.A.Thornton and H.F.Ivey.

Westinghouse Engr, Vol. 19, No. 5, 134-8 (Sept., 1959).

A great deal of the attention given to electroluminescence in recent years has been focussed upon a.c. lighting applications. Some examples are given here of possible application to switches and relays, image amplifiers, and audio or d.c. amplifiers.

621.383.2.032.35

2414 THE EFFECTS OF ELECTRODE RESISTANCE IN ELECTROLUMINESCENT CELLS. H.F.Ivey.

I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 335-40 (July, 1959).

The effects of electrode resistance on the voltage drop, the power dissipation, and the equivalent circuit constants of electroluminescent cells were calculated by means of linear transmission-line theory. In practice, electroluminescent cells have nonlinear characteristics which make the actual problem very difficult to solve. It is believed, however, that the present considerations serve to give a qualitative picture of the effects of electrode resistance in actual cells.

PARTICLE ACCELERATORS

621.384.612.12 : 537.54

2415 HIGH ENERGY, HIGH CURRENT SYNCHROTRON INJECTOR. G.R.Davies and P.R.Chagnon.
J. sci. Instrum., Vol. 36, No. 7, 306-8 (July, 1959).

The construction and testing of a pulsed 450 keV injector for an electron synchrotron are described. High voltage is obtained with a spark gap and pulse transformer. The electron-optical system consists of a series of electrodes connected to a voltage divider programmed so as to approximate the field in a space-charge-limited plane diode. Quadrupole leses are used to optimize the shape of the beam spot and to counteract space-charge spreading. Details are given of the dependence of beam current on energy and on filament power.

ELECTRON TUBES

621.385.032.213.13 : 537.533

2416 CATHODE WORK FUNCTION, SPARKING POTENTIALS AND SECONDARY IONIZATION COEFFICIENTS FOR OXIDE-COATED CATHODES IN HYDROGEN.
D.E.Davies and B.J.Hopkins.
Brit. J. appl. Phys., Vol. 10, No. 11, 498-501 (Nov., 1959).

The Kelvin vibrating electrode technique has been applied to measure the contact potential difference between oxide-coated cathodes and a gold reference surface in the presence of hydrogen. Special high vacuum (Alpert) techniques were used to ensure high gas purity. By the use of both calcium oxide and barium oxide cathodes, in various states of activation, it was possible to obtain a range of work function from 1·4 to 3·6 eV. Paschen curves were plotted for each of these oxide cathodes at room temperature, and minimum sparking potentials and secondary ionization coefficients were determined. A linear relation was found between the cathode work function and the minimum sparking potential. The slope of this line indicated that a 1 eV change in work function corresponded to a change of 55 V in the minimum sparking potential. The slope of the line was confirmed by independent work function measurements using the graph of the Richardson thermionic equation. The curves (ω/α)versus(E/p) showed a rapid increase in ω/α with decreasing values of E/p at $E/p<100$ V/cm mm of mercury.

621.385.032.213.13 : 537.533

2417 INFLUENCE OF THE CATHODE WORK FUNCTION ON THE SPARKING POTENTIAL IN HYDROGEN.
D.E.Davies and R.K.Fitch.
Brit. J. appl. Phys., Vol. 10, No. 11, 502-5 (Nov., 1959).

The Kelvin or vibrating electrode method of measuring contact potential differences has been used to follow changes in work function of evaporated metallic films in a parallel plate electrode system in hydrogen at about 10 mm of mercury pressure. A reduction in cathode work function of the order of 0.3 eV was effected by passing a current of 10^{-4} A for 10 s. After about 30 min the cathode work function returned to its original value. Similar treatment caused a reduction in the sparking potential of 30 V, which also returned to its original pre-discharge value in times of the order of 30 min. This, together with other experimental data, is consistent with the fact that positive ions from the discharge current remained on the cathode surface for periods up to 30 min after the current was switched off. It has been possible to demonstrate that, while these positive ions are being neutralized, there is a relationship between the work function of a cathode and its sparking potential in hydrogen.

621.385.032.213.13 : 621.317.332.1 : 537.533

NEW METHODS FOR THE MEASUREMENT OF CATHODE INTERFACE IMPEDANCE. See Abstr. 2117

621.385.1 : 621.382.3

A MODERN APPROACH TO SEMICONDUCTOR AND VACUUM DEVICE THEORY. See Abstr. 2387

621.385.12.032.212

2418 THE MAGNESIUM OXIDE COLD CATHODE AND ITS APPLICATION IN VACUUM TUBES.
A.M.Skellett, B.G.Firth and D.W.Mayer.
Proc. Inst. Radio Engrs, Vol. 47, No. 10, 1704-12 (Oct., 1959).

The MgO cold cathode is a new source of electrons with possible applications in various types of electron tubes. It consists of a thin layer of porous magnesium oxide on a nickel base. A strong electric field that exists across the layer while in operation is believed to produce the electron emission from the surface. Evidence supports the theory that avalanche multiplication occurs in the layer. This cathode glows with a pale blue luminescence during operation. The velocity distribution of the emitted electrons shows a peak at 13 eV. The outer surface potential has been measured and found to be of the order of 150 V with respect to the nickel base. The emission is not self-starting, and starting means are discussed. Noise, life, emission density, and temperature range of operation are discussed in so far as present knowledge permits. An experimental design of an amplifier tube employing this cathode is described and the characteristics of the tube are given.

621.385.6 : 537.533

2419 A LOW POTENTIAL COLLECTOR EMPLOYING AN ASYMMETRICAL ELECTRODE IN AN AXIALLY-SYMMETRIC MAGNETIC FIELD. D.A.Dunn, W.R.Luebke and G.Wada.
I.R.E. Trans Electron. Devices, Vol. ED-6, No. 3, 294-6 (July, 1959).

A collector for a beam-type tube with an axial magnetic focusing field can be made to operate at a potential near cathode potential without returning secondary electrons, if the beam is deflected and caused to pass an asymmetrical electrode properly positioned in the symmetric magnetic focusing field. Collection takes place in a region of radial electric field. Experimental results on such a device indicate successful operation, provided the velocity spread in the beam is not too large.

621.385.6 : 621.374.42

2420 THEORY OF A FAST-SWITCHING ELECTRON-BEAM FREQUENCY DIVIDER. N.M.Kroll and I.Palócz.
I.B.M. J. Res. Developm., Vol. 3, No. 4, 345-54 (Oct., 1959).

A velocity-modulated electron-beam microwave tube is described which can be operated as a frequency divider. Its operation is analysed in terms of velocity-modulation bunching theory, neglecting space-charge forces. Because of the existence of two stable states opposite in phase, such a divider can be advantageously employed in a microwave logical system. The transient behaviour of the device is discussed, particularly with reference to the time required to switch the device from one of its stable states to the other. Factors involved in the minimization of this time interval are analysed. See also Abstr.2988 of 1959.

621.385.623.5

2421 REFLEX KLYSTRONS AS RECEIVER AMPLIFIERS. K.Ishii.
Electronics, Vol. 33, No. 2, 56-7 (Jan. 8, 1960).

Describes the results of measurements to investigate the performance of 723A/B reflex klystrons as r.f. amplifiers at X-band. Using isolators and phase-shifters with the amplifier, a gain of 60 dB, a noise figure of 16 dB and a bandwidth of 2.5 Mc/s at 9360 Mc/s were obtained. R.C.Glass

621.385.623.5

2422 TRANSISTOR PHASE DETECTOR FOR PHASE-LOCK STABILIZATION OF A 30 000-Mc KLYSTRON.
R.W.Zimmerer.
Rev. sci. Instrum., Vol. 30, No. 11, 1052-3 (Nov., 1959).

To obtain a stable 5 mm generator a reflex klystron operating at 30 kMc/s and stabilized against the higher-order harmonics of a 3 Mc/s crystal-controlled oscillator was used. The power at 1 cm wavelength drives a crystal diode producing about 1 mW at 5 mm. The beat frequency of the klystron with the harmonic of the crystal oscillator is compared with a stable 15 Mc/s tunable oscillator in a transistor phase detector and the error signal used to control the klystron repeller voltage. Details of the phase detector are given. R.C.Glass

621.385.632 : 537.533

2423 ELECTRON BEAMS IN AXIALLY-SYMMETRIC CROSSED FIELDS. J.A.Bradshaw.
I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 257-61 (July, 1959).

M-type travelling-wave tubes use electron beams that drift in crossed electric and magnetic fields. One such tube, the axiotron, (see Abstr. 1456 of 1951), used a hollow beam drifting parallel to the tube axis in a radial electric field crossed by an azimuthal magnetic field. The addition of an axial magnetic field to the azimuthal one adds another degree of complication and flexibility to the beam equations, yet maintains their symmetry about the tube axis. It gives, in

effect, a helical magnetic field crossed by a radial electric field. The behaviour of hollow electron beams drifting in laminar flow through fields of the latter configuration is examined. A stability index for electron paths and four fairly general types of beam is defined. The stability index and the distribution of space charge obtainable in each type as functions of the amplitudes and directions of the fields and drift velocities may then be determined. In general, the density tends to be greatest at the inner beam radius, but it is possible to approach uniform density in stable beams. This report does not consider beam launching nor the "gun" problem; nor does it consider over-all beam instabilities such as scalloping.

621.385.633

2424 A BACKWARD-WAVE OSCILLATOR WITH PERIODIC SLOW-WAVE STRUCTURE FOR THE 27 TO 48 Gc/s FREQUENCY BAND. F.Gross.
Arch. elekt. Übertragung, Vol. 13, No. 8, 356-62 (Aug., 1959). In German.

The electron gun produces a circular beam with a diameter of 0.25 to 0.3 mm and a current density of 15 to 20 A/cm^2. The beam is focused through the interaction space of the slow-wave structure by a longitudinal permanent magnetic field. The rugged slow-wave structure is stacked from punched molybdenum or copper disks. It has a wide tuning range, low line-losses, and a fairly high coupling impedance. The element for coupling the r.f. power out of the slow-wave circuit and the vacuum window are designed for a large bandwidth. For line voltages between 550 and 3600 V the oscillator covers a tuning range from 26.5 to 48 kMc/s and supplies within this band a mean continuous-wave power of better than 40 mW.

621.385.644.2

2425 TUNING AND THE EQUIVALENT CIRCUIT OF MULTI-RESONATOR MAGNETRONS. T.S.Chen.
J. Electronics and Control, Vol. 7, No. 1, 33-51 (July, 1959).

The resonator system in a microwave magnetron possesses an infinite number of normal modes and constitutes an element with distributed parameters. Its circuit representation should consist of an infinite number of lumped LC branches representing these modes. The conventional equivalent circuit used in the qualitative evaluation of magnetron performance is inadequate for predicting such characteristics as the broadband tuning of magnetrons. The magnetron equivalent circuit is here synthesized from its input admittance function which can be determined from the characteristics of a guide used to tune the magnetron. The equivalent circuit comprises as many LC branches as the amount of information provided by the tuning data. The parameters in the circuit can be correlated with the inductance and capacitance of one side resonator that determine the block frequency of the tube. Agreement between measurement and prediction is obtained when the equivalent circuit is employed to calculate the tuning characteristics of the magnetron which is tuned by using different guides or a guide coupled to the tube by means of an iris.

621.385.832

2426 SELECTING A DEFLECTION YOKE. H.O.Marcy.
Electronics, Vol. 32, No. 50, 58-9 (Dec. 11, 1959).

Considers the scans presented on c.r. tubes for such displays as radar p.p.i.'s, random-located characters and rasters of all frequencies. The corresponding yoke requirements are described, and driving circuits outlined. The operation of aiding and bucking coils is explained with diagrams, and a table correlates yoke parameters and their typical values with the conditions determining them; an example is given. E.F.Hansford

621.385.832 : 533.5

2427 TITANIUM AS A GETTERING MATERIAL. R.L.Stow.
Nature (London), Vol. 184, 542-3 (Aug. 15, 1959).

Describes the use of titanium as a getter in cathode ray tubes. With barium getters ultimate pressures of 10^{-9} mm Hg were recorded but these were improved to 2×10^{-8} mm Hg by using titanium. The ion gauge was run continuously during both sets of measurements. A.E.I.Research Laboratory

621.385.833 : 537.533

2428 DENSE ELECTRON BEAMS. B.Meltzer.
Brit. J. appl. Phys., Vol. 10, No. 9, 391-7 (Sept., 1959).

The industrial context of electron beam design is sketched. The theoretical assumptions of classical trajectory behaviour and laminarity are discussed. Langmuir's diode analyses, Pierce's design method and Brillouin's magnetic collimation are described, as well as recent studies of the Pierce–Cauchy problem and self-magnetic effects in simple beams. Summaries are given of the conservation principles of beam dynamics, use of the action function in analysis and design, the position as regards computation, and some recent progress.

621.385.833 : 537.533

2429 LAMINAR FLOW IN MAGNETICALLY-FOCUSED CYLINDRICAL ELECTRON BEAMS. J.L.Palmer.
I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 262-9 (July, 1959).

The behaviour of a cylindrical electron beam in a magnetic field is discussed in terms of a laminar-flow model. By numerical integration of the equations of motion, the maximum and minimum radii of excursion and the wavelength of the undulations for each electron are presented in graphical form for various boundary conditions on the electron beam. By proper selection of boundary conditions, e.g., magnetic field strength at the cathode, the graphs are utilized to describe Brillouin flow, space-charge-balanced flow, immersed flow, confined flow, and, in fact, any electron flow which satisfies the laminar flow criterion. The perturbations introduced by improper injection conditions for any of the flows mentioned can be read directly from the graphs. A study of the wavelength and amplitude of such perturbations as a function of radial position in the beam determines if a given type of flow with given injection conditions satisfies the laminar flow criterion. The sensitivity of various types of electron flow to misadjustments of the boundary conditions is clearly revealed by the graphs; e.g., the amplitude of the undulations in Brillouin flow is very sensitive to the adjustment of the magnetic field strength, whereas for immersed flow, a similar deviation in magnetic field strength has very little effect on the amplitude of the undulations.

621.385.833 : 537.533

2430 THE RADIO-FREQUENCY CURRENT DISTRIBUTION IN BRILLOUIN FLOW. M.Chodorow and L.T.Zitelli.
I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 352-7 (July, 1959).

It has been shown that in an electron beam with Brillouin focusing, two pairs of space-charge waves are possible. One pair has the peculiar property of having no r.f. charge density in the volume of the beam, with most of the current being caused by ripples of the boundary. It is shown that, in the case of modulation by the gridless gap of a klystron, it is only these spacecharge waves which are excited in the electron beam. This result has also been verified elsewhere by experiment. In addition to the detailed calculation, a simple proof is given which demonstrates why one gets the particular behaviour predicted by the detailed theory, namely, a modulated beam with no r.f. charge density in the volume. This effect arises from the fact that the modulation is produced by an electric field with zero divergence, and therefore the r.f. velocity produced also has zero divergence. Zero divergence of the velocity is the condition for an incompressible fluid; i.e., constant density. In the case of modulation by a grid, the electric field does not have zero divergence, and this kind of behaviour does not occur.

621.385.833

2431 INVALIDITY OF THE LANGMUIR VACUUM DIODE THEORY. B.Meltzer.
J. Electronics and Control, Vol. 6, No. 6, 550-2 (June, 1959).

Presents deductive schemata showing that the classical Langmuir analysis of an infinite, planar, non-relativistic diode is self-contradictory, in assuming the magnetic field negligible. The implication for Pierce gun design is pointed out, and Winwood's criticisms of previous publications on this topic are discussed. B.Meltzer

621.386.71 : 620.179.152

2432 ON THE RADIOGRAPHIC MERITS OF THE 1000 PKV RESONANT TRANSFORMER AND THE VAN DE GRAAFF X-RAY GENERATORS. D.E.Elliott and C.M.Knowles.
Nondestr. Test., Vol. 17, No. 4, 205-9 (July-Aug., 1959).

An experimental comparison of a 1000 kV resonant transformer X-ray generator and a 1000 kV Van de Graaf X-ray generator was conducted based on the technical aspects of the units as they are applied to industrial radiography. Exposure techniques and resolution data from the radiography of aluminium sections up to 10 inch, steel sections up to 6 inch, and uranium sections up to 1 inch are presented. Field intensity distribution, experimental focal spot data, and direct radiographic enlargement data are also presented.

It is concluded that the resonant transformer unit has a slight advantage in the contact radiography of thin to moderate sections, and that the Van de Graaf unit has a slight advantage in the application to thicker sections and a definite advantage in direct radiographic enlargement.

GAS DISCHARGES
GAS-DISCHARGE TUBES

621.387 : 537.533

2433 CATHODE EMISSION MEASUREMENTS IN LOW PRESSURE DISCHARGES.

A.D.Forster-Brown and M.A.Cayless.
Brit. J. appl. Phys., Vol. 10, No. 9, 409-11 (Sept., 1959).

A method described in an earlier paper (Abstr. 5857 of 1957) for measuring the zero field emission from hot cathodes in discharges is compared with that of the probe methods described by Found. Good agreement is obtained, thus supporting the interpretation of the measured characteristics. It is shown how this method may be applied to measure the emission from cathodes in ordinary long discharge tubes, such as fluorescent lamps, without the necessity for inserting probes or interfering with the construction of the tubes or electrodes in any way.

621.387 : 537.52

2434 NOISE SPECTRA OF A PROBE IN A HOT-CATHODE DISCHARGE. C.Singh.

Proc. Phys. Soc., Vol. 74, Pt 1, 42-7 (July 1, 1959).

Measurements have been made with a floating and a biased probe of the low-frequency noise which occurs in hot-cathode discharges through mercury vapour at low pressures. As previously reported by Cobine and Gallagher (Abstr. 1522 of 1947), and Martin and Woods [Abstr.5177A of 1952; Proc. Phys. Soc., Vol. 65,281-6 (April, 1952)], the spectrum is continuous but there are no superimposed peaks of oscillation. The spectra agree with that of the tube noise in their general shape. It has been shown that the primary electrons from the cathode are not essential for the noise to be recorded from the probe.

621.387

2435 THE DIGITRON: A COLD-CATHODE CHARACTER DISPLAY TUBE.

N.McLoughlin, D.Reaney and A.W.Turner.
Electronic Engng, Vol. 32, 140-3 (March, 1960).

A range of cold-cathode display tubes is described and relative merits of side-and end-viewing tubes are compared. The principles of d.c. operation and use of the design data are explained. Various circuits for use with these tubes are given together with methods of using a.c. supplies.

621.387

2436 COLD-CATHODE TUBE CIRCUITS. H.Liebendörfer.

Electronic Radio Engr, Vol. 36, No. 12, 436-42 (Dec., 1959).

After a general outline of the basic principles of cold-cathode tube operation, including direct current and capacitor triggering methods, the application of the tube in some basic circuits is described. These include a timing circuit, a reversible counter circuit, an elementary pulse generator and a flame detector circuit. The paper provides a simple but good introduction to this type of application of cold-cathode tubes. J.MacCormack

621.387

2437 A GLOW COUNTING TUBE READ-OUT TECHNIQUE AND ITS APPLICATION. S.K.Chao.

I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 317-20 (Sept., 1959).

A technique is described whereby the content of a tube is recognized and read out through a carrier signal applied to the anode and 10 detectors connected to the 10 cathodes. The readout is nondestructive since it does not alter the content of the tube. A large number of glow tubes can be conveniently read out in this manner simply by connecting all corresponding cathodes together. The carrier signal is then successively distributed to their anodes. An example of such an application is given where 19 channels of four glow tubes each are read into an I.B.M. card punch.

621.387 : 621.039 : 539.17 : 537.52

2438 PHYSICAL MEASUREMENTS ON HEAVY-CURRENT DISCHARGES. R.M.Payne and S.Kaufman.

Proc. Instn Elect. Engrs, Paper 2900 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 36-42, 43-6).

Republication, with discussion, of the paper abstracted in Abstr. 3088 (1959).

621.387 : 621.039

2439 THE CALCULATION OF DISCHARGE CURRENTS IN A TORUS WITH A CONTINUOUS CONDUCTING LINER.

C.H.Tosswill and E.L.V.Hope.
Proc. Instn Elect. Engrs, Paper 2905 [Convention on Thermonuclear Processes] publ. April, 1959 (Vol. 106A, 101-6, 142-7).

Republication, with discussion, of the paper already abstracted as Abstr. 3089 (1959).

621.387 : 621.039 : 537.56

2440 RAPID COMPRESSION OF A PLASMA WITH AZIMUTHAL CURRENTS. G.B.F.Niblett.

Proc. Instn Elect. Engrs, Paper 2882 [Convention on Thermonuclear Processes] publ. April, 1959 (Vol. 106A, Suppl. No. 2, 152-7, 182-5).

Republication, with discussion, of the paper abstracted as Abstr. 3085 (1959).

621.387 : 537.56

2441 THE CIRCUIT DYNAMICS OF PLASMA. B.S.Liley.

Proc. Instn Elect. Engrs, Paper 2899 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 158-65, 182-5).

Republication, with discussion, of the paper abstracted as Abstr. 3087 (1959).

621.387.426

2442 CURRENT DEVELOPMENTS IN NEUTRON DETECTORS. F.Gardner.

Brit. Commun. and Electronics, Vol. 7, No. 3, 198-202 (March, 1960).

ELECTRONIC EQUIPMENT

621.389

2443 EVALUATION AND USE OF MILITARY SPECIFICATIONS FOR ELECTRONIC PARTS AND MATERIALS.

L.F.Bennett.
Brit. Commun. and Electronics, Vol. 7, No. 3, 186-8 (March, 1960).

621.389

2444 BRITISH APPROACHES TO MICROMINIATURIZATION. G.W.A.Dummer.

Electronics, Vol. 33, No. 1, 71-5 (Jan. 1, 1960).

Four possible approaches to microminiaturization are: (1) components assemblies — single or multiple components or plates stacked and connected by riser wires (micromodule system); (2) circuit assemblies — single complete circuit function on a plate; (3) solid assemblies — true solid circuits, single crystals with controlled resistivity areas, etc.; and (4) sealed tube assemblies — microminiature components sealed in subminiature tube cases. These are discussed, together with the production of high-definition film resistors, evaporated chromium and gold conductors and magnesium-fluoride-gold capacitors. Various problems common to all microminiaturization methods are presented. The proposed layout and circuit diagram of a binary counter microcircuit is given. Reference is made to possible future development of a range of small fully sealed flat-cased transistors which will not exceed 0.125 in. square or 0.125 in. diameter and 0.040 in. in thickness, and which will have flush electrode contacts. H.A.Miller

621.389 : 621.374.3

2445 THE COMPUTATION OF MUSCLE ACTIVITY FROM THE INTEGRATED ELECTROMYOGRAM.

B.R.Fink and M.L.Scheiner.
I.R.E. Trans Med. Electronics, Vol. ME-6, No. 3, 119-20 (Sept., 1959).

The integration of a signal of varying pulse amplitude and frequency is discussed. Several solutions are considered, and a method is described in which an accurate integration is obtained with a circuit of short time-constant and virtually infinite decay time.

621.389

2446 TRANSMISSION OF ULTRASOUND THROUGH LIVING HUMAN THORAX.

H.D.Crawford, J.J.Wild, P.I.Wolf and J.S.Fink.

I.R.E. Trans Med. Electronics, Vol. ME-6, No. 3, 141-6 (Sept., 1959).

Experiments are described demonstrating the passage of 1 Mc/s c.w. ultrasound through the heart and lungs at power levels of 100 mW/cm^2 at the transducer terminals (a total of 1.25 W). When the sound was directed through the region of the heart, the ultrasound was modulated by the moving intrathoracic structures in synchronism with the heart beat. The records obtained were modified both by exercise and by amyl nitrite administered to the subject, but remained synchronous with the heart rate. Modulation of the ultrasound did not occur in two warm corpses. Sonic energy at the levels used to traverse the thorax did not affect a simultaneously recorded electrocardiogram. No deleterious effects have been observed on a subject whose heart was irradiated at 1 W/cm^2 and 3 W/cm^2 (totals of 12.5 and 37.5 W, respectively) applied to transducer terminals at intervals over a period of one year. When c.w. ultrasound was directed through a lung field clear of the heart, it was found that the attenuation varied 50 dB between full inspiration and a lung emptying of 3400 cm^3 (0 dB = full inspiration). In addition to direct transmission, sound is scattered throughout the thorax. The mechanics of the ultrasonic phenomena are described.

621.389 : 621.317.39

2447 A STATISTICAL STUDY OF THE EFFECTS OF ELECTRIC FIELDS ON THE MOVEMENTS OF MAMMALIAN SPERM CELLS. J.W.Trank.

I.R.E. Trans Med. Electronics, Vol. ME-6, No. 3, 174-9 (Sept., 1959).

A micro technique has been developed to facilitate the study of electric field effects on the swimming pattern of sperm cells. The instrumentation for this technique, a micro-electrophoresis vessel, a metering motion-picture projector, and a simple analogue computer for data handling, are briefly described. It is shown expermentally that (1) an electric field imposed on a cell suspension acts primarily to direct the cells to the anode without appreciably changing their swimming speed; and (2) the field effects are not linear functions of field strength. It is postulated that the field effect is primarily galvanotaxis and that the cells seek a position of minimum stimulation and therefore must have a transverse sensitivity axis.

621.389 : 621.317.39

2448 SOME ENGINEERING ASPECTS OF MODERN CARDIAC RESEARCH.

D.Baker, R.M.Ellis, D.L.Franklin and R.F.Rushmer.

Proc. Inst. Radio Engrs, Vol. 47, No. 11, 1917-24 (Nov., 1959).

A system has been developed to make possible continuous analysis of the action of the heart in the healthy unanesthetized dog during its spontaneous activities. This system involves the continuous measurement of the pressure within the chambers of the heart, the size of these chambers, and the flow of blood out of the heart. Heart rate, stroke volume, average blood flow, effective cardiac power and work, and other information are continuously derived from the directly-measured parameters by means of analogue computers. Several new instruments were developed to solve the problems unique to measurement in an intact animal. The dimensions of the heart chamber are obtained by measuring the transit time of pulsed sound passing across the chamber. Blood flow is measured by comparing the upstream and downstream transit times of bursts of sound passing through the moving blood. An isothermal flow meter utilizing a tiny thermistor on the tip of a catheter provides an alternate measure of flow. A miniature, differential transformer type of pressure transducer was developed for measuring pressure within a heart chamber. The system provides a means by which hypotheses regarding cardiovascular function and control may be rapidly and accurately evaluated.

TELECOMMUNICATION

621.39

2449 THE NINTH PLENARY ASSEMBLY OF THE C.C.I.R. J.W.Herbstreit.

Proc. Inst. Radio Engrs, Vol. 48, No. 1, 45-53 (Jan., 1960).

621.391

2450 SCIENCE AND INFORMATION THEORY. [La science at la théorie de l'information]. L.Brillouin.

Paris : Masson et Cie (1959) x + 302 pp. In French.

This is a translation into French of the book which has already appeared in English. Various corrections have been added and the final chapters have been extended somewhat. The scientific theory of information is described in terms of the contributions made by Shannon and Gabor. The main purpose of the work is however, the application of the ideas of information theory to the problems of pure science. After describing its successful use in coding and telecommunications, the method and the system of reasoning are applied to problems in thermodynamics. In particular the position of statistical thermodynamics is consolidated by eliminating several paradoxes such as the Maxwell demon. It is shown that there is a strong connection between the ideas of entropy and information. The principle of negentropy of information is presented as a generalization of the second principle of thermodynamics. Other topics which are discussed include the uncertainty principle, the physical limits of observation, problems connected with the human use of information, computers. There are 74 figures and 14 tables. S.C.Dunn

621.391

2451 STATISTICAL SPECTRAL OUTPUT OF POWER LAW NONLINEARITY. O.J.M.Smith.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 535-43 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

This statistical treatment presents a method of describing non-Gaussian random signals, shows the harmonic power spectrum generated by non-linearities from random signals, demonstrates the calculation of the output power and the error power in a non-linear system and derives the criteria for stability in such systems. Different ways of deriving cross correlations of various orders are described. General non-linearities are expressed by means of a power series and their gain is derived in these terms. Filtering effect of non-linearities is considered. Non-Gaussian distributions are treated as non-linear effects on a Gaussian source.

T.Horrocks

621.391

2452 SPECTRAL OUTPUT OF PIECEWISE LINEAR NONLINEARITY. O.J.M.Smith.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 543-49 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

The transference or effective gain of piecewise linear component is derived. The output autocorrelation function of a clipper, a dead zone, and a general piecewise linear non-dynamic component is obtained by a double integration of the second probability density. The output power is a sum of Gaussian error integrals. This can be divided into fundamental or correlated power, and distortion power due to lack of desired signal or presence of harmonics. These concepts are applied to calculate the output of piecewise linear devices for various statistical inputs. T.Horrocks

TELEGRAPH AND TELEPHONE SYSTEMS

621.394.33

2453 STRAD — NEW CONCEPT FOR SIGNAL TRANSMISSION, RECEPTION, AND DISTRIBUTION. E.P.G.Wright.

Elect. Commun., Vol. 35, No. 3, 149-62 (1958).

A general discussion of the basic principles behind this electronic version of a torn-tape system capable of receiving, storing, and retransmitting different forms of coded information. There is a discussion of reliability, particularly from the point of view of equipment duplication, of storage problems leading to the use of a single common store for all incoming and outgoing lines in most cases and to the principles on which the size of the store is calculated, and on various miscellaneous matters such as the general flexibility of the system and the requirements for monitoring and

supervision. The circuits and components are not discussed in detail but there are illustrations of some of the more important units. G.A.Montgomerie

621.394.33

2454 A HIGH-SPEED SIGNALLING SYSTEM FOR USE OVER TELEPHONE CIRCUITS. A.P.Clark.
A.T.E. J., Vol. 15, No. 2, 157-72 (April, 1959).

This 600 baud signalling system is capable of transmitting information in binary form over any normal telephone circuit in Great Britain, and gives reliable and trouble-free operation. It uses an a.m. signal in which both sidebands are transmitted. The system has been extensively tested in the laboratory and over various telephone circuits. The operation of the system is described and the results obtained from the various tests are summarized. Various types of interference observed on the telephone circuits are listed, and their effects on the signalling system are considered.

621.394.34

2455 A NEW TELEPRINTER DIALLING SYSTEM WITH NON-FERROUS MOTOR SELECTORS. G.Hoffmann.
Elektrotech. Z. (E.T.Z.) B, Vol. 11, No. 9, 367-71 (Sept. 21, 1959). In German.

A new telex system developed by the Siemens and Halske A.G. employs non-ferrous motor selectors throughout. The outlet capacity can be divided in arbitrary groups, instead of the 10 and 20 outlet groups associated with Strowger type selectors. The system works on the marking principle and makes use of the register-markers. The block diagram of an exchange is shown and the establishment of local and long-distance connections is described. Dials or keyboards can be used. The operation of the register-marker is described in detail. J.M.Silberstein

621.394.34

2456 A HIGH-VOLUME HIGH-SPEED WEATHER INFORMATION DISTRIBUTION SYSTEM. E.E.Schwenzfeger.
Trans Amer. Inst. Elect.Engrs I, Vol. 78, 722-8 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

A proposed new system designed to meet the need for greater speeds, to avoid stations receiving unwanted weather information and to enable them to change their programme of required data speedily. The system is in effect a high-speed party-line network arranged to transmit data at 1000 words/min. There may be up to 1000 transmitting and 5000 receiving stations. The teleprinters at receiving stations can select the required data and the programme can be changed easily. The Burroughs matrix page-printer has been selected because of its ability to work at speeds up to 2000 words/min. L.B.Firnberg

621.395.341.7

2457 THE DEVELOPMENT OF REGISTER-TRANSLATORS FOR USE IN LARGE AUTOMATIC TELEPHONE NETWORKS. J.McGavin.
Trans S.African Inst. Elect. Engrs, Vol. 50, Pt.4, 82-96 (April, 1959).

621.395.347.4

2458 INDIALING TO P.B.X. EXTENSIONS: APPLICATION IN A STEP-BY-STEP CENTRAL OFFICE AREA. G.N.Schleinkofer.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 549-54 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Indialling provides a means for direct dialling from the public telephone network to the extensions of a private branch exchange. The adaptation of a large private Strowger exchange with a capacity of about 5 000 lines is described, as well as the re-arrangements in the main exchange. Block diagrams are given of both the main and private exchanges. Pulse-correcting circuits have been avoided by a system in which no more than two pulse repeaters are used in any one connection. Calls directly dialled to the extensions constitute about 90 per cent. of the incoming traffic. Transfer of a call from one extension to another is done by the intermediary of the switchboard. J.M.Silberstein

621.395.44

2459 A TRANSPOSITION SYSTEM FOR CARRIER SYSTEMS UP TO 156 Kc/s. B.M.Kirkland.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 612-14 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Gives basic data for the new B1 system, which can provide for 8 compandored carrier systems, and includes measured curves of far-end crosstalk between 4 combinations of pairs in a repeater section. F.F.Roberts

621.395.44 : 621.395.741

EFFECT OF TEMPERATURE ON THE ATTENUATION OF BALANCED PAIR CABLES FOR CARRIER CURRENTS. See Abstr. 1777

621.395.5

2460 TRUNK MECHANISATION IN BRITISH EAST AFRICA. J.L.Galvin.
A.T.E. J., Vol. 15, No. 2, 95-124 (April, 1959).

621.395.52

2461 AUTOMATIC OPERATION OF LONG-DISTANCE TELEPHONE TRAFFIC (IN FINLAND). S.Jalavisto.
Kraft o. Ljus, Vol. 32, No. 12, 279-83 (Dec., 1959). In Swedish.

Automatic operation between the principal towns of central and southern Finland is being developed. The country is divided into 80 network groups which are combined to form 9 distribution areas. It is characteristic of the Finnish system that each automatic trunk exchange is connected to every other by direct cable link; moreover each trunk exchange will be able to function also as a transit exchange so that a connection between one distribution area and another can be made either through a direct link or indirectly via other trunk exchanges. This choice of routes complicates the exchange equipment, but improves the utilization factor of the cables. Metering and control of automatic trunk traffic are also discussed. G.N.J.Beck

TELEPHONE EQUIPMENT
COMMUNICATION NETWORKS AND CABLES

621.395.64 : 621.372.3

2462 TRANSISTORIZED NEGATIVE IMPEDANCE CONVERTORS. Yu.L.Kurkin and A.A.Sokolov.
Elektrichestvo, 1959, No. 9, 66-71 (Sept.). In Russian.

Impedance converters, which are analysed, have input impedance equal to the load impedance but with reversed sign. Two-stage circuits of repeaters and inverters are considered. Among configurations discussed are: (1) voltage repeater–current repeater, stable in the short-circuited condition; (2) voltage repeater–current repeater in a short-circuited variation, stable in the open-circuited condition; and (3) voltage inverter–current inverter. Matrix equations are set and solved for various configurations; conversion stability and the range of transformed loads are calculated. Matrix transformation methods are shown giving most direct solutions. J.M.Silberstein

621.395.64

2463 A NEW TRANSISTORIZED NEGATIVE-IMPEDANCE TELEPHONE REPEATER.
R.P.Dimmer and E.L.Roback.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 673-78 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Negative impedance repeaters introduce into the transmission circuit a negative impedance or admittance which reduces the attenuation of the circuit. Combined shunt- and series-repeaters are mostly used and their installation involves a selection of components which are provided in great variety. The series-shunt repeater of the type AT-5 has only one adjustable gain control and in most cases can be installed by unskilled personnel. The network section comprising inductors, capacitors and resistors is pre-set assuming a loaded cable circuit of 88 mH per 6000 ft with a 0.5 section facing the repeater. Gain control affects the amplifier which converts the network into a negative impedance. A full circuit of the repeater is given and explained; performance curves are shown. J.M.Silberstein

621.395.665

2464 AUDIO VOLUME COMPRESSOR. E.C.Miller.
Electronics, Vol. 33, No. 2, 62 (Jan. 8, 1960).

A single stage transistorized unity gain compressor is described. It is designed to follow a microphone amplifier, the mean level being about −45 dB at an impedance of 10 000 ohms. A transistor amplifier is followed by an RC network incorporating three diodes, the impedance of the final diode being varied by the rectified voltage, thus

controlling the loss in the network. 15 dB of compression is available. The unit is not provided with any operating controls and is primarily intended for automatic operation on outside broadcasts, recorded interviews etc. It is convenient for one-man operation, the interviewer not having to worry about level changes with different talking distances etc. M.L.Gayford

621.395.722 : 621.313.322-84

2465 AUTOMATIC STARTING OF DIESEL-ALTERNATOR SETS AT A GENERAL POST OFFICE EXCHANGE. T.J.Pavitt.

Engl. Elect. J., Vol. 16, No. 3, 17-22 (Sept., 1959).

A description of the Birmingham Anchor Exchange standby power plant with particular reference to automatic starting. The standby supply is obtained from three 300 kVA diesel sets, each driving a 270 kW 0.9 p.f. 415 V 3-ph. 4-wire alternator, two of which are arranged for automatic starting. The switchgear and control gear, automatic starting, mains restoration and control and tripping supplies are described in detail. Test facilities include simulated mains failure and testing of the engine control circuits and alarm without causing a changeover of the load. J.W.Lee

621.395.741 : 621.315.2

2466 TRANSMISSION PROPERTIES OF POLYETHYLENE-INSULATED TELEPHONE CABLES AT VOICE AND CARRIER FREQUENCIES. G.S.Eager, Jr, L.Jachimowicz, I.Kolodny and D.E.Robinson.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 618-40 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Gives details, with results presented graphically or in tables, of measurements of the primary and secondary transmission parameters, and of far-end and near-end crosstalk, of 100-pair cables over 1-1000 kc/s. Some data on temperature-dependence and moisture-dependence are included for certain parameters. Test equipment and theoretical aspects of some parameters are outlined in appendices. F.F.Roberts

621.395.743 : 621.315.221

2467 MANUFACTURE OF COMPOSITE CABLE SHEATH FOR TELEPHONE EXCHANGE CABLE. D.A.Hughes.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 650-4 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

The polythene-insulated conductors are surrounded by a corrugated aluminium sheath and an outer polythene jacket is extruded over the aluminium. Another version contains an additional steel sheath over the aluminium. V.G.Welsby

621.395.743 : 621.315.2

2468 THE DESIGN AND MANUFACTURE OF DIRECT BURIAL WIRE. J.L.Robb and W.L.Roberts.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 662-6 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Deals with a wire designed for underground telephone distribution, consisting of two copper conductors (one tinned for polarity identification) in a polyethylene core with a flat steel armour-shield coated with thermoplastic flooding compound and sheathed overall with p.v.c. A quasi-elliptical cross-section is adopted as a compromise between flat oval circuit and circular-shield balanced pair. Problems involved are discussed, particularly those of capacitance, and relative formulae are given. Over 1000 miles of this type of buried wire have been installed in the field, and among the conclusions reached are: (1) the carrier capabilities are quite limited, but electronic developments may eliminate this shortcoming; such developments may also extend the loop-limit capabilities of this wire; (2) the wire is now available as a standard outside plant facility at a cost which compares favourably with open-wire construction in those areas where high-speed wire ploughs can be used. H.A.Miller

ELECTROACOUSTIC APPARATUS

621.395.61 : 534.23

2469 TRANSDUCERS AND THEIR EQUIVALENT ELECTRIC CIRCUITS; APPLICATION TO MICROPHONES. N.Rouche.

Acustica, Vol. 6, No. 3, 317-23 (1956). In French.

It is shown that a system analogous to that set up by Fischer (see, for example, Abstr. 1236 of 1954) can be established on a general basis. All possible forms of the transducer equations compatible with the conservation of energy are examined from this standpoint.

621.395.62 : 534.23

2470 MAGNETOSTRICTIVE TRANSDUCERS WITH MECHANICAL LOADS. R.R.Whymark.

Acustica, Vol. 6, No. 3, 277-87 (1956).

The influence of mechanical loads upon a window-type magnetostrictor is considered and the deductions checked by measurements. The loads consist of thin stubs either parallel or exponentially tapered. Liquid loads are simulated with high loss structures and optimum loading values are experimentally determined. The results are verified by calculations involving the mechanical Q of the load material. The electromechanical efficiency is measured and an optimum value of 42% is obtained for the mounted magnetostrictor, which agrees closely with the value predicted from the theory. Brief investigations of transducer damping with low loss loads are also performed and the results indicate methods for the basic design of practical transmission systems.

621.395.62

2471 A COMPATIBLE STEREOPHONIC SOUND SYSTEM. F.K.Becker.

Bell Lab. Record, Vol. 37, No. 11, 410-14 (Nov., 1959).

After a description of the historic experiments in stereophonic sound reproduction carried out in the Bell laboratories, an outline is given of the modern theory of binaural listening and sound location. It is possible to control the virtual source position by varying the reproduced channel signal intensities and delay times. If arrival times differ by more than a few milliseconds, the precedence (de Haas) effect operates in a way which is now well known. This effect is the basis of the system described here. Two or three normal spaced microphone channels are provided with mutual cross-connection circuits which incorporate 5 to 10 milliseconds of delay and 0 to 3 dB of attenuation, the optimum values depending on the programme matter. The delayed signals obtained from the cross connections do not noticeably deteriorate the stereophonic reproduction, but they do enable a well balanced pick-up from two or more microphones to be achieved for listeners on any one channel alone, the small delays not being significant for monophonic listening. Some trials have been carried out and it is claimed that fully compatible stereophonic broadcasts are possible, it not being necessary appreciably to dilute the stereophonic effects in order to give single channel listeners a completely satisfactory result. M.L.Gayford

621.395.62

2472 SOME INVESTIGATIONS CONCERNING DIRECTIONAL PERCEPTION. N.V.Franssen.

Tijdschr. Ned. Radiogenoot, Vol. 24, No. 6, 321-35 (1959). In Dutch.

The theory of binaural and stereophonic hearing is surveyed. The hypothesis is formulated that the direction of a round is determined to an important degree by transients, a simple circuit for testing this being shown. An electrical model of binaural hearing mechanism and the phenomena occurring in stereophonic reproduction are explained and the effect of time and intensity differences between the two loudspeakers is shown. Methods of compressing the stereo. information are discussed. G.N.J.Beck

621.395.62

2473 STEREOPHONY AND THE FILM — TRUE AND PSEUDO SYSTEMS. W.Grau.

Elektron. Rdsch., Vol. 13, No. 7, 253-9 (July, 1959). In German.

A survey of true and pseudo stereophony in general, special applications to the film industry also being considered. The limitations of true stereophony in the cinema are discussed. For example, the normal "wave-front" type of true stereo give poor depth perspective and no vertical location. For special effects in films, the excitation of suitably placed auxiliary loudspeakers in the auditorium by means of "pan-potting" and pilot frequency switching etc., is very effective. The principles of "delay-stereo" are touched on. Similar sound tracks are reproduced by magnetic heads whose relative positions can be changed by means of a controlled drive. Other effects such as "tone-colour stereo" are mentioned, the manipulation of the high-frequency polar responses of microphones being illustrated. A chart summarizes the various systems applied to films. Two- and three channel systems are analysed in some detail, the original localization experiments of Steinberg and Snow as well as De Boer's

work being described. Localization contours for constant intensity differences and constant time delay differences for 2 and 3 channel systems are given. The extension of the effective stereo listening area by splitting multiple stereo channels between several loudspeakers to form overlaid 2 channel systems is described. The general conclusion is that it is necessary to add special effects to true stereo in order to get the best effects. M.L.Gayford

621.395.62

2474 STEREO BROADCASTING TECHNIQUE. J.J.Geluk.
Tijdschr. Ned. Radiogenoot., Vol. 24, No. 6, 337-52 (1959). In Dutch.

Methods of achieving compatible stereophony, using intensity differences only, are described. Circuits for locating the microphone position in the loudspeaker reproduction field are explained. Special stereo-microphones have been developed each containing two microphone elements possessing different principal directions and directional characteristics. Switching with stereo-microphones is discussed. The addition of reverberation is mentioned, giving the principles of stereo control room equipment. The h.f. transmission of stereo signals is dealt with for the case of a double f.m. system, crosstalk, s./n. ratio and phase characteristics being discussed. From the technical view point stereophonic transmission is feasible, but studio technique must be developed to overcome aesthetic objections. G.N.J.Beck

621.395.623

2475 BASIC REQUIREMENTS FOR A STEREOPHONIC SYSTEM. N.H.Crowhurst.
J. Audio Engng Soc., Vol. 5, No. 3, 129-34 (July, 1957).

The exact reproduction of a three-dimensional sound field is fundamentally impossible, so perfect stereophony cannot be realized. The success of any practical system must depend upon the degree to which it achieves an illusion of realism. Some physiological aspects of hearing and the means by which kinds of sound are identified are examined and demonstrated, to show the relative importance of intensity, phase, and transient effects in multichannel systems. The so-called "true" stereophonic is not so effective as artificially improved versions. The basic requirements for an economical stereophonic system using single-channel recording are deduced and demonstrated.

621.395.623.7

2476 PHASE SHIFT IN LOUDSPEAKERS. W.R.Stroh.
I.R.E. Trans Audio, Vol. AU-7, No. 5, 120-4 (Sept.-Oct., 1959).

A simple method of measuring the phase characteristic of a loudspeaker is described and typical phase curves are given for moving-coil and electrostatic loudspeakers. Distortion in correlation functions measured with an electrostatic loudspeaker is described and related to the phase characteristic of the speaker.

621.395.623.7

2477 PROBLEMS OF BASS REPRODUCTION IN LOUDSPEAKERS. E.M.Villchur.
J. Audio Engng Soc., Vol. 5, No. 3, 122-6 (July, 1957).

The special problems of speaker bass performance — harmonic distortion, frequency range, and uniformity of response (an index of transient response) — are discussed, and approaches to their solution are made.

621.395.623.7

2478 A CORNER LOUDSPEAKER WITH COAXIAL ACOUSTICAL LINE. T.S.Korn.
J. Audio Engng Soc., Vol. 5, No. 3, 138-41 (July, 1957).

A corner cabinet with the loudspeaker coupled to a quarter-wave coaxial re-entrant acoustical line exhibits full acoustical loading at a frequency as low as 38 c/s with the volume reduced to less than 2.2 ft. The rigidity of the walls being assured by the shape of the acoustical line, the structure of the cabinet can be very light and inexpensive. The lateral resonances of the loudspeaker inherent to tuned loading devices are damped by a series acoustical resistance, which does not affect the power transfer at the desired low-frequency end. The system gives true 360^0 sound distribution in the horizontal plane, independent of frequency. At high frequencies, a large portion of the radiated power is sent to the upper parts of the listening room, enhancing the ratio of the reverberated to the direct sound and meeting more closely the acoustical atmosphere of a concert hall.

621.395.625

2479 SOME NOTES ON ARTIFICIAL REVERBERATION. C.E.R.A.Moura and S.L.Campos.
J. Audio Engng Soc., Vol. 5, No. 4, 182-6 (Oct., 1957).

The considerations that affect the design of a method for producing synthetic reverberation are reviewed and an echo chamber system is described.

621.395.625.3

2480 MORE BANDWIDTH FOR MAGNETIC RECORDERS. D.R.Steele.
Electronics, Vol. 33, No. 2, 44-7 (Jan. 8, 1960).

A description of completely transistorized record and reproduce circuits for covering the band 250 c/s-250 kc/s. The recording amplifier has an input impedance of 10 kΩ and consists of an emitter-follower and a penultimate stage feeding a complementary-symmetry pair. Negative feedback ensures a constant current characteristic but top boost, amounting to 3 dB at 250 kc/s is provided. A sinusoidal bias supply is derived from a 1 Mc/s square-wave master oscillator. On the playback side, a preamplifier, located behind the head assembly, provides a gain of 38 dB. The playback amplifier proper consists of amplitude and phase equalizers, a 3-stage voltage amplifier, attenuator and output amplifier. Separate equalizer networks in parallel are provided for each of the four operating speeds, the junction between an amplitude and a phase equalizer being earthed when that particular network is not in use. H.G.M.Spratt

621.395.625.3

2481 THE ESTIMATION OF CHANNEL CAPACITY IN MAGNETIC TAPE RECORDING. H.Völz.
Elektron. Rdsch., Vol. 13, No. 6, 210-12 (June, 1959). In German.

The method of determination of the channel capacity, in bits/sec, of a communication system is described in order to provide a basis for estimation in the case of magnetic tape. Here, the derivation is complicated by the existence of two uncorrelated noise sources, ground noise and modulation noise, the latter assuming particular importance since its amplitude rises with signal level. The derivation leads to an expression for the tape capacity, in bits/cm, equal to C/v, where v is the tape speed and C the channel capacity, a quantity involving the channel bandwidth, dynamic range and percentage modulation noise. H.G.M.Spratt

621.395.625.3

2482 THE "NULL METHOD" OF AZIMUTH ALIGNMENT IN MULTITRACK MAGNETIC TAPE RECORDING. A.G.Evans.
I.R.E. Trans Audio, Vol. AU-7, No. 5, 116-20 (Sept.-Oct., 1959).

A number of methods for azimuth alignment were investigated. A technique for alignment which compares the output from two tracks of a multitrack tape provided a substantial improvement in alignment accuracy as compared to the methods which had been in use up to this time. A method for adjusting the lateral position of the head across the width of the tape was also developed which made use of the same basic principles as the "null method" of azimuth alignment.

621.395.625.3

2483 DIGITAL RECORDING OF ELECTROCARDIOGRAPHIC DATA FOR ANALYSIS BY A DIGITAL COMPUTER. L.Taback, E.Marden, H.L.Mason and H.V.Pipberger.
I.R.E. Trans Med. Electronics, Vol. ME-6, No. 3, 167-71 (Sept., 1959).

A corrected orthogonal 3-lead system was used to record electrocardiograms, directly from patients, using three f.m. channels of magnetic tape. A pilot facility was designed and assembled by N.B.S. to permit a medical technician to inspect these on an oscilloscope and select a significant cardiac cycle. This is automatically sampled at millisecond intervals and numerical values are stored in digital form on magnetic tape acceptable to an electronic computer. Objective analysis of large quantities of biological data by a variety of possible criteria is then possible.

621.395.625.3 : 681.142

2484 FACTORS INFLUENCING THE APPLICATIONS OF MAGNETIC TAPE RECORDING TO DIGITAL COMPUTERS. D.P.Franklin.
J. Brit. Instn Radio Engrs, Vol. 20, No. 1, 9-21 (Jan., 1960).

The merit of magnetic tape for storage of digital information and the benefits of abandoning linear in favour of two-state operation are briefly discussed. Limitations on the density of recorded information are reviewed to show the extreme precision called for in the

manufacture of magnetic heads and tape guidance mechanisms. Design features made necessary by high speed and acceleration requirements are considered with reference to a recently developed high performance tape handler.

621.395.625.3 : 681.142

2485 A MAGNETIC DISK, RANDOM ACCESS MEMORY. A.C.Glover.

J. Brit. Instn Radio Engrs, Vol. 20, No. 1, 22-4 (Jan., 1960).

A large capacity, random access storage device is described which uses 50 rotating magnetic disks. Total storage capacity is 5×10^8 alphanumeric characters with access time between 0.15 and 0.8 sec.

621.395.625.3 : 681.142

2486 MAGNETIC FILM FILE FOR COMPUTER STORAGE. A.S.Johnston.

J. Brit. Instn Radio Engrs, Vol. 20, No. 1, 25-30 (Jan., 1960).

A 35 mm oxide-coated film store is described in which the pick-up head is out of contact with the oxide. The high-quality backing medium provided by the film has resulted in complete freedom from drop outs. Interchangeability between all mechanisms has been achieved with available production heads, by using special auto-strobing circuits.

621.395.625.3 : 681.142

2487 A HIGH-DENSITY FILE DRUM AS A COMPUTER STORE. L.Knight and M.P.Circuit.

J. Brit. Instn Radio Engrs, Vol. 20, No. 1, 41-5 (Jan., 1960).

Describes a large-capacity magnetic drum store having a capacity of $\sim 15 \times 10^6$ bits and an average random access time of ~ 200 msec. A packing density of just over 10^6 bits/in. has been obtained by floating specially designed heads on a film of oil which automatically maintains a spacing of 0.002 in. between the head and the drum surface. Special considerations led to the use of a copper-nickel-iron alloy for the drum surface. A self-clocked reading system is used to obviate the need for high mechanical stability. The reading circuit also has special features which keep it operating under optimum conditions over a range of signal amplitudes.

621.395.625.3

2488 CONCEPT OF A NEW MAGNETIC RECORDING MEDIUM. J.H.Orr.

J. Audio Engng Soc., Vol. 5, No. 3, 127-8 (July, 1957).

A suggested new method of producing magnetic tape is described which avoids the development of craters in the coating surface by casting a magnetic film on a casting belt with the base subsequently laminated to the reverse side.

621.395.625.3

2489 MAGNETIC MODULATOR PLAYBACK TECHNIQUE FOR AUDIO APPLICATIONS. M.E.Anderson.

J. Audio Engng Soc., Vol. 7, No. 4, 243-5 (Oct., 1959).

Describes the design and performance of a head which follows the now recognized principle of incorporating two magnetic circuits, one, including the gap, which picks up the signals from the tape and the other a closed circuit excited to saturation from a source within the range 10-400 kc/s. Depending upon the bias and signal range with respect to the magnetic characteristic of the tape, the output circuit consists either (a) of a network tuned to the 2nd harmonic of the excitation frequency and an amplitude demodulator or (b) of a phase or synchronous demodulator. The output signal is proportional to the recorded signal and not to its derivative. Accordingly, the head is capable of reading tape recordings at speeds down to and including zero but the output will approach zero as the recorded wavelength approaches the air gap length or rises to a value exceeding the tape-head contact length. A signal/noise ratio of 50 dB is claimed. H.G.M.Spratt

621.395.72 : 621.318.1

METALLIC MAGNETIC MATERIALS AND CORE SHAPES IN TELECOMMUNICATION ENGINEERING. See Abstr. 2180

RADIOCOMMUNICATION

621.396.2

2490 THE CARRYING CAPACITY OF TWO-BEAM LINKS. B.S.Tsybakov.

Radiotekhnika i Elektronika, Vol. 4, No. 7, 1116-23 (July, 1959). In Russian.

Considers a transmitter of given power radiating a signal with a limited frequency spectrum such that the propagation conditions can be assumed the same for any spectral frequency. Two waves are assumed to arrive at the receiving aerial by two different paths. A simple expression is obtained for the carrying capacity in the case of a uniform spectral distribution of the Gaussian additive noise. The decrease in the carrying capacity due to the presence of the 2 reception paths is shown to be not greater than 15%. D.E.Brown

621.396.2

2491 THE CARRYING CAPACITY OF CHANNELS WITH A LARGE NUMBER OF BEAMS. B.S.Tsybakov.

Radiotekhnika i Elektronika, Vol. 4, No. 9, 1427-1433 (Sept., 1959). In Russian.

See preceding abstract. The expression obtained for the carrying capacity of a multibeam link with a uniform spectral density of the Gaussian additive noise is the same as that obtained earlier by Siforov (see Abstr. 485 of 1959) but the mathematical proof is more rigorous and the conditions of applicability of the expression are discussed. The carrying capacities of multibeam links are compared with those of one- and two-beam links. D.E.Brown

621.396.2

2492 A NEW HIGH-CAPACITY MICROWAVE RELAY SYSTEM. C.G.Arnold, V.E.Isaac, H.R.Mathwich, R.F.Privett and L.E.Thompson.

Trans Amer. Inst. Elect. Engrs 1, Vol. 78, 712-22 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

The MM-600 system operates on a line-of-sight basis for total distances up to 4000 miles. It will provide 600 channels on each of 12 r.f. channels operating with f.m. in the band 1700-2300 Mc/s, or alternatively, one TV black and white or colour channel on each r.f. channel. All voice channels have a bandwidth of 4 kc/s and are in accordance with C.C.I.R. standards. Repeaters are required at an approximate spacing of 30 miles; any number of channels may be dropped at each repeater and up to 60 inserted. The 10 ft dish radiates 15 W, and has a gain of 32.6 dB at 1700 Mc/s and 36.5 dB at 2300 Mc/s. Service channels, using voice channels, are suitable for carrying data-transmission signals and also display and remote-control facilities, allowing up to 20 operating conditions to be reported automatically. L.B.Firnberg

621.396.41

2493 OPTIMIZED COMPATIBLE A.M. STEREO BROADCAST SYSTEM. H.B.Collins, Jr and D.T.Webb.

I.R.E. Trans Broadcasting, No. PGBC-14, 2-15 (Nov., 1959).

A two-channel multiplex system is described. System objectives including compatibility, service area, and programme quality are discussed. Three different methods of creating the equivalent transmitted signal are reported, and conversion of present-day monaural stations to stereo by each method is indicated. The design of receivers for recovering the two stereo tracks is examined showing the signals derived by various means of detection. Emphasis is placed on a design resulting in a reliable, minimum cost receiver. Field test equipment and results are briefly considered and the level of performance that can be obtained from the system is stated.

621.396.5

2494 VOICE RADIO SYSTEMS FOR HIGH NOISE PATHS. J.A.Greefkes and F.de Jager.

Electronics, Vol. 32, No. 50, 53-7 (Dec. 11, 1959).

Describes a system which gives intelligible speech with a signal-noise ratio as low as 4 dB. This is effected by splitting the voice signals into frequency and amplitude components. At the transmitter a differentiating network gives pre-emphasis for a more uniform frequency spectrum. The signal is then single-sideband modulated at 60 kc/s and applied (a) to a clipper and filter (the frequency channel) and (b) to an envelope detector and a low-pass (0-100 c/s) filter (the amplitude channel). The two channels are transmitted at a convenient carrier frequency. At the receiver the two demodulated channels are fed through filters to a combining

amplitude modulator and thence through filters to an output integrator. Noise reduction is attributable to the action of the amplitude modulator and to the restricted bandwidth of the amplitude channel. H.G.M.Spratt

621.396.5 : 621.396.931

2495 A NEW MANUAL MOBILE TELEPHONE SYSTEM. A.F.Culbertson.

I.R.E. Trans Vehicular Commun., No. PGVC-13, 73-82 (Sept., 1959).

The system gives party line service but includes fully selective calling. This facility uses sequential 600/1500 c/s tone frequency shifting, the first transition after the operator's initiating signal resetting all decoders in the mobile equipments. The fixed control terminal includes an automatic gain adjusting amplifier to handle talker volumes between –8 and –48 voice units. This range includes an allowance of 17 dB for long distance toll circuits terminating in the mobile service. Keying of the signalling oscillator is effected by a bistable transistor switch. W.G.Stripp

TRANSMITTERS . RECEIVERS

621.396.61 : 621.317.34

2496 MEASUREMENT OF DISTORTION AND CROSSTALK IN HIGH-POWER SHORT-WAVE TRANSMITTERS. H.J.Ellissen.

Fernmelde-Ingenieur, Vol. 14, No. 2, 30 pp.(Feb., 1960). In German.

Measurements of linear and non-linear distortion and crosstalk on single and double side-band transmitters are described and the causes of these disturbances are discussed in detail. Means for reducing these effects are also illustrated.

621.396.61/.62

2497 NEW U.H.F. AIR-TO-GROUND COMMUNICATIONS FOR THE BRITISH ARMED FORCES. J.G.Cottrell; D.C.Dalton.

Brit. Commun. and Electronics, Vol. 6, No. 8-9, 586-91 (Aug.-Sept.); No. 10, 692-7 (Oct., 1959).

A new u.h.f. transceiver is described, developed in U.S.A. and engineered in U.K. It covers 225 to 400 Mc/s in 100 kc/s steps, the receiver having a sensitivity of 1 μV for 10 dB s.n.r. and a bandwidth of ±30 kc/s at 6 dB down. The 19 standardized sub-units, which include ventilation and monitoring facilities, can be combined in two basic receivers, two basic transmitters and two amplifiers, the latter used to increase the transmitter power of 10 W to a maximum of 150 W. An indirect frequency synthesis system is employed; three groups of ten crystals supply reference frequencies to three mixer circuits, with two a.f.c. control loops locking the desired frequency; the coarse control is mechanical, by means of a tuning motor; the fine control operates a phase discriminator and a reactance valve. A general engineering description of the equipment is given, illustrated by block diagrams and photographs. A.Landman

621.396.62 : 621.397.62

2498 THE COMBINED TELEVISION–RADIO RECEIVER AND ITS PROBLEMS. R.S.Hildersley.

J. Brit. Instn Radio Engrs, Vol. 20, No. 2, 155-66 (Feb., 1960).

The large number of frequency allocations in and around Band II compared with Bands I and III causes a serious selectivity problem in domestic combined receivers for television and f.m. sound broadcasts. The sound bandwidth of a television receiver is usually of the order of 500-1000 kc/s and since the frequency allocations of commercial radio transmitters are liable to be within 500 kc/s of the B.B.C. transmitters, interference can occur. Interference can also occur between the various B.B.C. regional transmitters whose frequency separation is usually 400 kc/s, but may be as little as 200 kc/s. The problem and a number of different solutions are discussed in detail. The circuit details of a commercially available combined receiver are then described. The sound i.f. circuits incorporate a double superheterodyne system, and the frequency of its r.f. oscillator is stabilized in Band II by means of an inexpensive a.f.c. system. Methods are described for measuring accurately the selectivity of a Band II receiver.

621.396.621 : 621.391.812.7

V.H.F. SOUND BROADCASTING. SUBJECTIVE APPRAISAL OF DISTORTION DUE TO MULTI-PATH PROPAGATION IN F.M. RECEPTION. See Abstr. 2525

621.396.621.59

2499 THE REACTION OF SUPERREGENERATOR ON AN EXTERNAL E.M.F. OF A CONTINUOUS AND IMPULSIVE CHARACTER. G.B.Ol'derogge.

Radiotekhnika, Vol. 14, No. 14, 32-41 (Oct., 1959). In Russian.

In is suggested that superregeneration would be suitable for use in a transponder in a meteorological radiosonde. The response of the circuit to a suddenly applied harmonic wave is calculated and by the usual process the response to the pulsed carrier is deduced. The majority of the paper is devoted to operation in the linear regime. There is also brief mention of operation in the nonlinear fashion whereby an appropriate choice of the grid circuit time-constant introduces a finite delay before the response is elicited. S.C.Dunn

RADIOFREQUENCY EQUIPMENT

621.396.66 : 621.397.62

2500 ONE-TUBE OSCILLATOR MIXERS FOR TV AND F-M TUNERS. E.H.Hugenholtz.

Electronics, Vol. 33, No. 3, 76-9 (Jan. 15, 1960).

The wellknown circuit technique of using a single triode as an oscillator-frequency changer on v.h.f. is analysed with particular emphasis on operation without an r.f. stage. The two incorporated bridge circuits are described; the one, introducing positive feedback at i.f. to increase the triode output impedance, the other to cancel the oscillator signal radiating into the aerial coupling network. The addition of balanced diodes in the input circuit is shown to reduce such radiation and 2nd harmonics. To raise the gain of a single-valve tuner the use of a frame-grid pentode instead of a triode is briefly considered. A.Landman

AERIALS

621.396.67

2501 DIAGRAMS OF DIRECTIVITY OF A VERTICAL DIPOLE IN THE NEIGHBOURHOOD OF A CYLINDRICAL PARALLEL PARASITIC [ELEMENT], IN THE HORIZONTAL PLANE. H.Baret.

Ann. Telecomm., Vol. 14, No. 9-10, 220-35 (Sept.-Oct., 1959). In French.

A formula is derived for the radiation pattern for the case where the driven element and the parasitic are neither thin, nor geometrically identical. An expression is derived for the radiation field in terms of the geometrical parameters of the elements and their input- and transfer-admittances. The admittances are calculated by Hallen's method which does not assume, a priori, a sinusoidal current distribution. Data and radiation patterns calculated from the results are quoted for element spacings of 0.1 λ, 0.25 λ and 0.75 λ for the case of identical elements, and are shown to be in better agreement with experiment than results calculated from other theories. Two cases where the elements are non-identical are also calculated. G.D.Sims

621.396.67

2502 MEASUREMENTS ON RECEIVING AERIALS FOR TELEVISION AND METRE-WAVES. O.Bryhni.

Elektrotek. T., Vol. 73, No. 2, 17-22 (Jan. 15, 1960). In Norwegian.

Describes a rapid automatic method for display of aerial polar radiation diagrams. A large radar-type c.r.t. is used for display. Its deflection coils can be rotated by a synchro unit, and the aerial to be measured is mounted on a 6 m mast which can be rotated either by hand or by a controlled built-in motor. The apparatus can also be used for impedance measurements. Radiation patterns and impedance charts obtained with the equipment are shown for dipoles and 10-element Yagi arrays. G.N.J.Beck

621.396.67

2503 ESTIMATING VOLTAGE BREAKDOWN PERFORMANCE OF HIGH-ALTITUDE ANTENNAS. W.J.Linder and H.L.Steele.

I.R.E. WESCON Convention Record, Vol. 3, Pt 1, 9-16 (1959).

An outline is given of the factors influencing voltage breakdown

in uniform airgaps at heights up to 300 000 ft. Experience has shown that a useful estimate of the breakdown strength of the non-uniform field around an aerial can be made based on the uniform field data. These data are presented graphically. Similarity rules are given which can be applied to the scaling of a model so that laboratory checks of breakdown power can be made. Experimental data confirming the validity of this approach are given. W.T.Blackband

621.396.67

2504 AERIAL SUPPORTING STRUCTURES. P.J.Ward.

Point to Point Telecomm., Vol. 4, No. 2, 24-44 (Feb., 1960).

Reviews some of the basic considerations involved in the design and erection of aerial supporting structures.

621.396.677

2505 FERROMAGNETIC AERIALS FOR EMERGENCY TRANSMITTERS. G.Ziehm.

Elektron. Rdsch., Vol. 13, No. 6, 213-18 (June, 1959). In German.

The efficiency of ferromagnetic aerials as well as the field strength over the sea, as a function of distance, is calculated at three frequencies: 0.5, 2.182 and 8.634 Mc/s. Experiments on a particular transmitter of permissible weight and power supply with an output of one watt yield reliable results at a distance of 20 nautical miles for field strength ~ 1 μV/m at 0.5 and 2.182 Mc/s and 2 to 3 μV/m at 8.364 Mc/s. Z.F.Voyner

621.396.677

2506 THE SYNTHESIS OF A LINEAR RADIATOR AND ITS ANALOGY IN THE PROBLEM OF WIDEBAND MATCHING. L.B.Tartakovskii.

Radiotekhnika i Elektronika, Vol. 3, No. 12, 1463-74 (1958). In Russian.

It is shown that a physical and mathematical analogy exists between the problem of constructing a linear aerial for a given radiation pattern and that of constructing an inhomogeneous transmission line with a given frequency dependence of the reflection coefficient. The problem of the linear radiator is dealt with in detail. An iteration method is proposed for the solution of the linear equation common to both problems. Two cases of practical importance are considered, the second of which is analogous to the wideband matching of a load with large phase excursion of reflection coefficient over a given frequency band. [English summary: PB 141106T-11, obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.]. R.C.Glass

621.396.677

2507 EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON PLANE SURFACE AERIALS. S.Blume.

Z. angew. Phys., Vol. 12, No. 1, 39-47 (Jan., 1960). In German.

Contributes to the theory of plane surface aerials. A solution of Maxwell's equations for non-rotationally symmetrical radiators of this kind is obtained. As a limiting case an aerial represented by a sector of a circle is taken. Particular solutions are obtained for the TEM-wave in an elliptical cone and for the E and H-waves in elliptical conical-coordinates. Z.F.Voyner

621.396.677.5

2508 CURRENT AND POTENTIAL DISTRIBUTION ON A CIRCULAR LOOP ANTENNA. P.O.Brundell.

K. Tekn. Högsk. Handl., No. 154, 33 pp. (1960).

The current and potential distribution on a circular loop aerial is investigated. Following Hallen's theory special reference is made to their travelling-wave character.

PROPAGATION . INTERFERENCE

621.391.8

2509 RADIO TRANSMISSION BY IONOSPHERIC AND TROPOSPHERIC SCATTER. A REPORT OF THE JOINT TECHNICAL ADVISORY COMMITTEE. J.T.A.C. I. IONOSPHERIC SCATTER TRANSMISSION. II. LONG-RANGE TROPOSPHERIC TRANSMISSION.

Proc. Inst. Radio Engrs, Vol. 48, No. 1, 4-29, 30-44 (Jan., 1960).

621.391.812 : 551.5

2510 EFFECT OF ATOMIC TESTS ON RADIO NOISE. C.A.Samson.

Nature (London), Vol. 184, 538-9 (Aug. 15, 1959).

Two high-altitude atomic explosions over Johnston Island in the Pacific, shortly after midnight on Aug. 1 and Aug. 12, 1958, appear to have had a rather pronounced effect on the radio noise recorded at Kekaha, Hawaii, about 700 miles N.W. of Johnston Island. In the hour following the blast, the noise decreased by as much as 32 dB at some frequencies at a time of day when it would normally be rising or holding steady. Recovery to normal levels apparently occurred in a matter of hours at 13 kc/s and 5 Mc/s, but at 51, 160, 545 kc/s and 2.5 Mc/s a changed pattern was evident for several days, with levels at night much below normal. Similar effects were observed in the case of the second explosion. The length of time over which there was an apparent increase in the night-time absorption of noise suggests that high-altitude nuclear explosions may have a rather persistent effect on radio communications at certain frequencies. A.Wilkinson

621.391.812.3

2511 PROBABILITY DISTRIBUTION OF NOISE DUE TO FADING ON MULTISECTION F.M. MICROWAVE SYSTEMS. H.E.Curtis.

I.R.E. Trans Commun. Syst., Vol. CS-7, No. 3, 161-7 (Sept., 1959).

Measurements of fading on a single path are given and an estimate of the probability distribution of expected noise due to fading on a particular 68-section system of which the single path is typical part is derived. A comparison is shown with a measured cumulative distribution curve of noise at baseband subsequently obtained on the long system under operating coditions. A numerical method of combining distribution curves was used in this case and the so-called "breaking effect," due to deep fades, is included. This method is described. The paper is directed specifically to a particular microwave system but the principles described can be applied equally well to others.

621.391.812.3

2512 MULTIPLE DIVERSITY WITH NONINDEPENDENT FADING. J.N.Pierce and S.Stein.

Proc. Inst. Radio Engrs, Vol. 48, No. 1, 89-104 (Jan., 1960).

Previous analyses of diversity techniques are extended to include the performance of an optimum (maximal-ratio) combiner in the case of nonindependent signal-fading fluctuations, for an arbitrary number of diversity branches. The analysis includes the general possibility of correlations among the quadrature components of the various signals. Some computational simplifications for certain cases of physical interest are given, as well as a specific application to two problems in digital communications.

621.391.812.3

2513 STATISTICAL ANALYSIS OF FADING ON SHORT-WAVE TRANSMISSIONS. K.K.Aggarwal.

J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 4, 230-7 (Sept., 1959).

A statistical analysis is presented of fading records taken on oblique-incidence m.c. transmissions as well as on pulsed transmissions at vertical incidence. The amplitude distributions of some of the random fading curves are shown. It was observed that the probability distributions of the amplitude in such fading curves are the conventional Rayleigh, Gaussian and log normal type. Autocorrelograms of the fading curves were also determined in a few cases and are presented. Fading records of the oblique-incidence c.w. transmissions were compared with those taken simultaneously on vertical incidence pulsed transmission at the equivalent vertical incidence frequencies.

621.391.812.33

2514 SIGNAL STRENGTH AND FADING OF 10 CM WAVES AS A FUNCTION OF AERIAL AZIMUTH.

R.Schlinemann and G.Pucher.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 2, 37-42 (July, 1959). In German.

Results of an experimental study of the variation of signal strength with aerial azimuth are reported. The experiments were performed at a wavelength of 10.2 cm, using a dish 4 m diameter, over a distance of 76 km. The results are presented in graphical form. A.E.Karbowiak

621.391.812.621

2515 SIMPLE METHODS FOR COMPUTING TROPOSPHERIC AND IONOSPHERIC REFRACTIVE EFFECTS ON RADIO WAVES. S.Weisbrod and L.J.Anderson.

Proc. Inst. Radio Engrs, Vol. 47, No. 10, 1770-7 (Oct., 1959).

Describes a simple and accurate method for computing ionospheric and tropospheric bending. The only assumptions made are that the refractive gradient is radial and that the refractive index profile can be approximated by a finite number of linear segments whose thickness is small compared with the earth's radius. These assumptions are readily justifiable in all practical cases. Since there are no limitations on the angle of elevation and the shape of the refractive index profile, the method has a wide application and it is extended to cover other refractive effects such as retardation, Doppler error and Faraday rotation.

621.391.812.622

2516 RADIOWAVE PROPAGATION IN LOW TROPOSPHERIC DUCTS. V.A.Fok, L.A.Vainshtein and M.G.Belkina.
Radiotekhnika i Elektronika, Vol. 3, No. 12, 1411-29 (1958). In Russian.

A detailed mathematical analysis is given of radiowave propagation in tropospheric ducts (inversion layers) for the case where the communication points both lie within the duct. The method is applied to a number of cases of tropospheric propagation. The results enable a comparison to be made of long-distance propagation at various wavelengths. These show that long-distance tropospheric duct propagation attenuates very little with increase in wavelength. Thus the wavelength may exceed the critical wavelength by an order of magnitude and propagation still occurs. The criteria governing long-distance propagation are discussed. [English summary: PB 141106T-11, obtainable from Office of Technical Services, U.S. Department of Commerce, Washington D.C., U.S.A.].

R.C.Glass

621.391.812.623 : 538.56

2517 DIFFRACTION OF ELECTROMAGNETIC WAVES BY SMOOTH OBSTACLES FOR GRAZING ANGLES.
J.R.Wait and A.M.Conda.
J. Res. Nat. Bur. Stand., Vol. 63D, No. 2, 181-97 (Sept.-Oct., 1959).

The diffraction of electromagnetic waves by a convex cylindrical surface is considered. Attention is confined primarily to the region near the light-shadow boundary. The complex-integral representation for the field is utilized to obtain a correction to the Kirchhoff theory. Numerical results are presented which illustrate the influence of surface curvature and polarization on the diffraction pattern. Good agreement with the experimental results of Bachynski and Neugebauer (see Abstr. 6393 of 1958) is obtained. The effect of finite conductivity is also considered.

621.391.812.624

2518 ANGULAR DIVERSITY RECEPTION AT 2290 MC OVER A 188-MILE PATH.
J.H.Chisholm, L.P.Rainville, J.F.Roche and H.G.Root.
I.R.E. Trans Commun. Syst., Vol. CS-7, No. 3, 195-201 (Sept., 1959).

Experiments were performed over the 188 mile Round Hill–Crawfords Hill path at 2290 Mc/s, to determine the feasibility of using angular diversity reception in a tropospheric scatter system. Using a 28 ft reflector, two beams were produced with two separate feed systems. The correlation of the signals received on one of the two beams with that received on the other was determined for various spacing of the beams, as well as for the azimuthal position of the aerial. These experiments show that angular diversity techniques can be effective depending on the proper choice of frequency, aerial size, and beam separation for paths in the neighbourhood of 200 miles in length. A substantial "diversity gain" can be achieved even though partial correlation exists. These results also appear to be in good agreement with theoretical predictions for equal means and for the short periods of time applicable to obtaining reliable voice and high-speed teletype communications.

621.391.812.624

2519 TROPOSPHERIC SCATTER PATH LOSS TESTS — FLORIDA BAHAMAS. K.P.Stiles.
I.R.E. Trans Commun. Syst., Vol. CS-7, No. 3, 205-8 (Sept., 1959).

Path loss tests were made over a nine-week period on the Florida–Nassau path using a frequency of 1970 Mc/s. These tests are discussed and some comparisons are drawn between them and path loss tests made to Cuba at 800 Mc/s years earlier. The Nassau tests indicated that a satisfactory 60-channel radio system could be provided through use of 10 kW transmitters and 30 ft parabolic aerials.

621.391.812.624

2520 AN INVESTIGATION OF THE SCATTERING OF RADIO WAVES BY TROPOSPHERIC INHOMOGENEITIES IN REFRACTIVE INDEX BY A METHOD OF RADIO-ASTRONOMICAL MEASUREMENT. M.A.Evdokimov.
Radiotekhnika i Elektronika, Vol. 3, No. 12, 1430-40 (1958). In Russian.

An investigation of tropospheric scattering of solar radiation using a polarization-type radiometer working at 3.2 cm is described. Scattering by small and large inhomogeneities was measured. The results show good agreement with the measurements of Southworth (1945) and the theoretical results of Booker and Gordon (1950) and Booker and Bettencourt (1955). (English summary: PB 141106T-11, obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.).

R.C.Glass

621.391.812.63 : 538.56

2521 A DISCUSSION OF IONOSPHERIC DEMODULATION NEAR GYRO FREQUENCY. G.L.Goodwin.
Austral. J. Phys., Vol. 12, No. 2, 157-63 (June, 1959).

Observations made in Adelaide of the ionospheric demodulation of radio waves near gyro frequency at vertical incidence are discussed. The effect occurs in the region of about 90 km, and does not appear to decrease through dawn. An F-layer reflected wave is demodulated by unequal amounts during its two passages through the region The large magnitude of the effect and its lack of dependence on modulation frequency seem to be inconsistent with the theory of wave interaction.

621.391.812.63 : 538.56

2522 MEASUREMENT OF THE IONOSPHERIC ABSORPTION ON 2.5 MC/S AT AHMEDABAD. J.S.Shirke.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 3, 115-20 (June, 1959).

Measurements were carried out at Ahmedabad (latitude 23°0' N, longitude 72°6' E) using vertical pulsed transmission from August 1957 to July 1958. The strength of the transmitted signal was kept constant and the intensities of the vertically reflected pulses were reduced by the use of a passive attenuator so as to give constant intensity of signal on the oscilloscope screen of the receiving circuit. It was found that mean monthly values of the absorption plotted against $\cos\chi$ for each month from August 1957 to July 1958 obeyed a relation of the type $\log\rho \propto \cos^n\chi$. The value of "n" for individual months ranges from 0.64 to 0.89 and the mean value is 0.73. To eliminate the effects of seasonal changes in the noon zenith distance of the sun, values of absorption for $\cos\chi = 1$ were obtained by extrapolation. These extrapolated values show fairly close correlation with the sunspot number. Generally, maximum absorption is reached some time after local noon, suggesting relaxation time for D region. Absorption larger than that expected by the $\cos\chi$ law is observed in the late evening hours. This is attributed to a contribution from the deviative type of attenuation in the E layer.

621.391.812.63 : 538.56

2523 SOME INVESTIGATIONS ON LONG-WAVE PROPAGATION. S.N.Mitra.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 3, 121-36 (June, 1959).

Describes some experimental observations on propagation at 164 kc/s from Radio Tashkent (42° N, 69° E) to Delhi (28°35' N, 77°5' E) over a distance of 1650 km. The amplitude of the received wave was continuously recorded at Delhi. The recordings show well-defined sudden increases in amplitude (and gradual fall) coincident with solar flares. The data from 9 August to 16 December 1958 were analysed and 144 instances of sudden increase observed during the period. It is found that flares of all classes of importance give rise to sudden increases in amplitude (s.i.a.). The times of beginning and maximum of these two events agree fairly well (within 5 to 10 min). The variation of H_α line width during a flare is also well correlated, in some instances, with the change in amplitude of the corresponding s.i.a. The height of reflection of this obliquely incident long wave is determined from sunrise effect and is 65 km. The usefulness of s.i.a. as a flare patrol and in short-term forecasting of s.i.d. is discussed.

621.391.812.63 : 538.56

2524 IONOSPHERIC IRREGULARITIES AND PROPAGATION AT FREQUENCIES ABOVE THE "CLASSICAL" M.U.F.
A.K.Saha.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 3, 136-9 (June, 1959).

Sweep-frequency pulse measurements, carried out elsewhere, have shown that the maximum usable frequency via the F1 and F2 layers may be extended by an anomalous mode of propagation. The extension may be 10-15% above the value calculated from classical theory and is observed only during daytime. It is absent

at night. The phenomenon has been ascribed by some authors to scattering by irregularities present in the reflecting layers. Attention is drawn in this connection to the weak short-wave reflections observed at vertical incidence from heights below the normal E layer. These reflections are obtained during daytime and the reflecting layer merges during night-time with the meteoric E layer responsible for v.h.f. forward scatter propagation. It is argued that the extension of the "classical" m.u.f. may be due to scattering produced by irregularities responsible for the above weak reflections. It is possible that a part of the energy enters the skip zone due to forward scatter during the upward and downward path of the wave through the region containing the irregularities.

621.391.812.7 : 621.396.621

2525 V.H.F. SOUND BROADCASTING. SUBJECTIVE APPRAISAL OF DISTORTION DUE TO MULTI-PATH PROPAGATION IN F.M. RECEPTION. R.V.Harvey.
Proc. Instn Elect. Engrs, Paper 3221 E, publ. March, 1960, 10 pp. To be republished in Vol. 107B (1960).

In f.m. reception the delayed signals caused by multi-path propagation result in unwanted amplitude and phase modulation of the primary signal, and consequent distortion of the programme output of the receiver. The paper describes the results of tests which were carried out in simulated multi-path conditions to determine the importance of the parameters of both the received signal and the receiver in influencing the subjective annoyance caused by the distortion. With a well-designed receiver, the distortion of piano music is "slightly disturbing" when a single delayed signal is present having an equivalent path difference of 8 km and an amplitude of 35% relative to the primary signal. For a path difference of 29 km, however, the permissible relative amplitude is only 6% for the same subjective annoyance. Under the same conditions the distortion of speech is imperceptible. In comparison, receivers providing inadequate suppression of the unwanted amplitude modulation are much more susceptible to the distortion. The use of pre- and de-emphasis appreciably reduces the distortion, being equivalent to a reduction of about 8 dB in the amplitude of the delayed signal when the path difference is about 16 km. Similarly, the distortion is less noticeable when the loudspeaker has a poor response at high audio frequencies. The mechanism of multi-path distortion is discussed, and the harmonic spectra of the distortion shown for particular conditions.

621.391.812.7

2526 AN EXPERIMENTAL EQUIPMENT TO REDUCE TELEPRINTER ERRORS IN THE PRESENCE OF MULTIPATH. J.L.Hollis.
I.R.E. Trans Commun. Syst., Vol. CS-7, No. 3, 185-8 (Sept., 1959).

Multipath propagation between radio terminals employing binary signalling elements produces a catastrophic rise in teleprinter error rate when the difference in path delay time becomes appreciable compared to the duration of a bit. A commonly used four-channel multiplex system has a bit length of 6.7 ms and is thus seriously affected by differences in path delay greater than approximately 3 ms. A method of preventing the rise in errors when multipath propagation is present, by synchronously shifting the frequency of the transmitter and receiver following transmission of each bit is discussed. The receiver is thus responsive to the signalling element propagation by the shortest path and rejects the long path signals by filter selectivity. Spectrum occupancy and receiver bandwidth considerations which determine the magnitude and number of frequency changes are discussed, and a practical system is described. The general features of equipment used in testing this device are illustrated and discussed. The compatability of the anti-multipath equipment with existing equipment and the ability to reduce the error rate substantially, under conditions of ground-scatter multipath propagated by the F layer were successfully demonstrated.

621.391.812.7

2527 APPLICABILITY OF MULTIPATH PROTECTION TO METEOR BURST COMMUNICATIONS. T.G.Knight.
I.R.E. Trans Commun. Syst., Vol. CS-7, No. 3, 209-10 (Sept., 1959).

Investigates past methods of improving the duty cycle of meteor scatter links in the presence of multipath distortion and suggests using a technique, for further improvement, which has proved useful at h.f. It notes also, that use of this technique in conjunction with improved end-of-message error detection techniques should yield an improved duty cycle for meteor burst communications.

621.391.82 : 551.5

2528 OBSERVATIONS OF "WHISTLERS" AND VERY LOW FREQUENCY PHENOMENA AT GODHAVN, GREENLAND. E.Ungstrup.
Nature (London), Vol. 184, 806-7 (Sept. 12, 1959).

Preliminary analysis of whistler data obtained at Godhavn over the period July 1957-July 1958 shows that, compared with observations at lower latitudes, there is a lack of low frequencies (minimum frequency ~5 kc/s) and a high "nose frequency" (~16 kc/s). This suggests that the whistlers penetrate the ionosphere at about 5.° south of Godhavn, and travel by waveguide propagation along the earth to the observation point. Some details of observations of tweeks, chorus, and hiss are also given.

G.M.Brown

621.391.822

2529 ON THE NEED FOR REVISION OF NOISE GRADES FOR INDIA. B.B.Ghosh and S.N.Mitra.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 4, 194-9 (Sept., 1959).

Measurement of atmospheric noise in the frequency range 2.5-9.5 Mc/s has been in progress at the Research Department of All India Radio, New Delhi, since November 1955. Measured data are compared with predicted values for Delhi from C.C.I.R. Report No. 65. It is observed that predicted values are invariably low and the difference between the two has, at times exceeded 40 dB. It is concluded that noise grades predicted in theC.C.I.R. report do not represent conditions prevailing in India and there are sufficient justifications to warrant their revision.

621.391.827

2530 CROSSTALK DUE TO FINITE LIMITING OF FREQUENCY-MULTIPLEXED SIGNALS. C.R.Cahn.
Proc. Inst. Radio Engrs, Vol. 48, No. 1, 53-9 (Jan., 1960).

The amplitude distribution of the composite signal for a large number of channels is essentially Gaussian and the crosstalk can be calculated with reasonable accuracy by assuming that the input signal is random noise, except for a narrow gap in which a sine wave is inserted to represent the signal in a selected channel. This assumption allows use of standard analytical techniques to determine the output signal-to-crosstalk ratio in the selected channel as a function of the clipping level. The resulting value for infinite clipping is about 9 dB. The crosstalk decreases rapidly as the clipping level is raised, and a value of 40 dB is obtained for clipping 1% of time. An optimum clipping level, which provides the highest signal-to-total-interference ratio, may be determined when noise is present in the receiver, and allows definition of "peak factor allowance". An allowance of several dB is found to be adequate for frequency-multiplexed binary data channels.

621.391.832.4

2531 NON-LINEAR DISTORTION IN FREQUENCY DIVISION MULTIPLEX WITH A LARGE NUMBER OF CHANNELS. J.Schwob.
Ann. Telecomm., Vol. 14, No. 11-12, 277-88 (Nov.-Dec., 1959). In French.

A review of some 16 papers relevant to the above title — mostly of recent publication. Provided that the number of channels is high it is found that the results obtained by the various authors are in good agreement. The present paper compares the assumptions made in the calculations, and the methods of calculation for various types of distortion. A summary of the basic results obtained is included.

G.D.Sims

RADIO APPLICATIONS . RADAR

621.396.932

2532 V. H. F. RADIO LINKS FOR SHIPS. E.Kulvik.
Tekn. Ukeblad, Vol. 106, No.25, 541-7 (June 18), No.26, 565-70 (June 25, 1959). In Norwegian.

A review of international agreements on v.h.f. ship radiotelephony. The 152-174 Mc/s band has been allocated for short-distance ship-to-ship and ship-to-land communication (154.5-156 Mc/s for Norwegian use). International technical specifications are discussed and the co-ordination of v.h.f. radiotelephony with harbour radar systems is dealt with.

G.N.J.Beck

621.396.933.2

2533 SOME FACTORS IN THE DESIGN OF V.H.F. AUTOMATIC DIRECTION FINDERS. S.A.W.Jolliffe.
Marconi Rev., Vol. 22, 168-98 (Fourth Qtr, 1959).

The reasons for direction finding in the v.h.f. band and the need for automatic display of bearings are discussed. Basic systems are analysed and some of the more interesting design features of a preferred system are discussed in detail. The performance of a typical automatic direction finder is stated.

621.396.933.2

2534 OPERATIONAL APPLICATIONS OF V.H.F. DIRECTION FINDERS. S.A.W.Jolliffe.
Marconi Rev., Vol. 22, 199-214 (Fourth Qtr, 1959).

Practical application of the modern ground-based v.h.f. direction finder as an aid to aircraft navigation is considered. Factors limiting the accuracy are discussed and, where possible, systems are compared in terms of technical performance and capital and operating costs.

621.396.933.2

2535 BEARING ERRORS IN MEDIUM FREQUENCY AUTOMATIC DIRECTION FINDERS. R.W.Sharples.
Marconi Rev., Vol. 22, 225-33 (Fourth Qtr, 1959).

A number of causes of error in automatic direction finders caused by receiver circuitry and design are analysed. An automatic direction finding system is briefly described and errors inherent in its design discussed under two headings. The first type of error is that caused by motor torque being produced at the loop null position, when the loop should be at rest. Several different causes of spurious motor input are discussed, with particular attention to spurious coupling with the loop amplifier stage. Errors due to lack of sensitivity in the servo system are then analysed and the effect of loop input phasing is discussed.

621.396.946

2536 CONCERNING OPTIMUM FREQUENCIES FOR SPACE VEHICLE COMMUNICATION.
S.Perlman, L.C.Kelley, W.T.Russell, Jr and W.D.Stuart.
I.R.E. Trans Commun. Syst., Vol. CS-7, No. 3, 167-73 (Sept., 1959).

Some of the newer technical developments that increase sensitivity to weak signals are evaluated for their potential increase in the distance of communication. Individual building blocks are then married to each other in operating systems that determine the optimum portions of the frequency spectrum. Equipment factors are examined first, both as to their individual characteristics and their dependence on each other. Next, propagation factors are examined for their effect over the range of the r.f. spectrum in providing windows for communication through the earth's atmosphere, troposphere, and ionosphere to outer space. Some consideration is given to the effects of auroral displays, water vapour and gaseous absorption, Faraday rotation of polarization, and radio star scintillations. In addition, there is a discussion of noises arising from various causes. Measurements by radio astronomers demonstrate that equivalent noise temperature is a more useful measure of signal-to-noise ratio of receiver performance than the standard noise figure definition.

621.396.946 : 621.376

2537 A CIRCUIT FOR MEASURING WEAK SIGNALS WITH CONTINUOUS SPECTRUM. S.M.Kozel.
Radiotekhnika, Vol. 14, No. 11, 55-7 (Nov., 1959). In Russian.

In a previous paper (see Abstr. 778 of 1959) it is alleged that the authors did not give a sufficiently clear account of the possibilities of some detecting circuits nor did they provide a sufficiently quantitive comparison between the various possibilities. In the present note it is established that the fluctuation limit of the accuracy of the coherent measuring circuit is always higher than in the compensating circuit and is lower than with the modulation method. However, in cases where the internal noise at the input of the amplifier is completely uncorrelated the fluctuation limits of the coherent and null-modulating method practically coincide. S.C.Dunn

621.396.96

2538 RADAR JAMMING CHART. R.A.Wall.
Electronics, Vol. 32, No. 49, 116-18 (Dec. 4, 1959).

A nomogram is given, based on the standard equations for intensities, for finding the range of a radar set operating in the field of another source of signals, whether this source is located at the target or not. It is necessary to specify arbitrarily a ratio between wanted signal and jamming signal at which the jamming may be regarded as preventing the use of the radar; then, from a knowledge of the position, power and gain of radar and jammer, the useful range is given from a set of straight-line logarithmic nomogram scales. An example is given for: (1) main beam towards jammer; and (b) main beam away from jammer. N.Corcoran

621.396.96

2539 HOW SOLAR NOISE CALIBRATES RADARS. J.A.Kuecken.
Electronics, Vol. 32, No. 52, 44-5 (Dec. 25, 1959).

Describes a method of checking aerial bearing by an optical sighting of the sun combined with the simultaneous measurement of solar noise. R.C.Glass

621.396.96 : 523.16

2540 RADAR ECHOES FROM THE SUN. V.R.Eshleman, R.C.Barthle and P.B.Gallagher.
Science, Vol. 131, 329-32 (Feb. 5, 1960).

An account of the Stanford University experiments 1958-9.

621.396.962

2541 A UNIFIED ANALYSIS OF RANGE PERFORMANCE OF C.W., PULSE, AND PULSE DOPPLER RADAR. J.J.Busagang, P.Nesbeda and H.Safran.
Proc. Inst. Radio Engrs, Vol. 47, No. 10, 1753-62 (Oct., 1959).

The method assumes that detection occurs when a set threshold is exceeded and is based on (1) a modification of the conventional radar equation which relates range with the signal-to-noise ratio; (2) a simplified analysis of a single channel consisting of range gate, bandpass filter, square-law detector and post-detection integrator which leads to an approximate calculation of the probability of detection; (3) a consideration of multi-channel effects. Although pulse radar has been extensively analysed, the literature on the performance of c.w. and pulse Doppler radars is meagre. This paper attempts to fill this gap. The method should prove useful for evaluating changes in a radar or comparing two radars. In order to estimate the radar range of a single radar, experiments to "calibrate" the model are required. A radar whose range is experimentally known can serve as a standard of comparison for predicting the behaviour of radars under development. Examples illustrate the method and suitable graphs are given

TELEVISION

621.397.2

2542 INVESTIGATIONS INTO REDUNDANCY AND POSSIBLE BANDWIDTH COMPRESSION IN TELEVISION TRANSMISSION. K.Teer.
Philips Res. Rep., Vol. 14, No. 6, 501-56 (Dec., 1959).

Three different aspects of redundancy present in normal television transmission are considered: (1) the statistical aspect, which is conceived with probability distributions of brightness, (2) the physiological aspect, which is conceived with the properties of the eye, (3) the psychological aspect, which is related to levels of consciousness. After this analysis of redundancy, transmission systems with narrow bandwidth are described in which bandwidth compression is effected by a decrease in the number of frames per second, viz., by decreasing the field frequency or the information per field. For practical realization of the former method a suitable memory device is needed. Considerations are restricted to this memory device, in particular to a vidicon-type camera tube. A decrease of the information per field can be realized by use of dot-interlace and subcarrier techniques, which are examined in detail. Finally, the use of these principles in colour television is considered, mainly with the N.T.S.C. system and a two-subcarrier system.

621.397.2 : 621.396.2

2543 EXPERIENCE WITH LONG-DISTANCE TELEVISION FIELDS USED FOR RETRANSMISSION. W.L.Braun.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 594-6 (1959) = Commun. and Electronics, No. 45, (Nov., 1959).

A brief engineering report on the use of long distance "diffraction" fields (over 90 miles) for a community TV aerial system for re-transmission, to receive channel 2-13 v.h.f. signals in a difficult terrain between two mountain ranges. The signal increases with height to a maximum, then to a minimum, and then to a lower maximum again. General conclusions are that the signal by night was

6-10 dB higher than by day, that occasionally the propagation will suffer from very rapid deep fades similar to aircraft flutter, and that aerial gain should take place in the smallest possible physical volume, and with minimum height array. A.Landman

621.397.331

2544 MAGNETIC RECORDING OF COLOR TELEVISION. J.Roizen.

Electronics, Vol. 33, No. 1, 76-9 (Jan. 1, 1960).

In the Ampex recording system, torque and drag variations cause a slight hunting effect, at 5 - 10 c/s, of the motor driving the head assembly. The resulting time-base displacement is not visible in monochrome recording but causes objectionable shift in hue in colour television. To overcome this, the 3.58 Mc/s colour burst signal at the beginning of each line is made to excite a local oscillator which continues to ring throughout the rest of the line. This oscillation is used to correct the phase of the I and Q chrominance components. The technique, although giving appreciable improvement, is not considered wholly satisfactory owing to frequency drift of the ringing oscillator. A recorded pilot signal at 3.58 Mc/s + 5 would give constant correction throughout the line but so far it tends to give rise to beats with the colour video signals. H.G.M.Spratt

621.397.331.2

2545 A METHOD OF TESTING TELEVISION CAMERA TUBE COLOUR RESPONSE. A.G.Warren.

Electronic Engng, Vol. 32, 144-7 (March, 1960).

A method is described, using fairly simple equipment, of obtaining the complete colour response of a monochrome television camera. A display of effective camera colour response to any chosen illuminant can be obtained, but tests so far have been confined mostly to studio tungsten-type lighting.

621.397.331.2 : 621.385.832 : 537.533

2546 ELECTROSTATIC OPTICS FOR CAMERA TUBES. R.W.Redington, G.A.Saum and P.J.Van Heerden.

I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 297-9 (July, 1959).

Two versions of an electrostatic focusing and deflection system suitable for camera tube applications are described. Focusing properties, resolution and aberrations are discussed.

621.397.331.22

2547 THE TESTING AND OPERATION OF 4½-in. IMAGE ORTHICON TUBES. D.C.Brothers.

J. Brit. Instn Radio Engrs, Vol. 19, No. 12, 777-805 (Dec., 1959).

The method used by a broadcasting organization to check the performance of image orthicon tubes are described. Aspects dealt with include: the transfer characteristic; sensitivity; contrast handling ability; signal/noise ratio; picture sharpness; geometrical distortion and linearity; microphony; uniformity of picture background; freedom from spurious effects; lag, movement blur, sticking, etc; colour response; freedom from drift; ease of adjustment. Some conclusions are drawn on particular aspects of operating these tubes.

621.397.331.222

2548 THE PROBLEM OF LAG IN PHOTORESISTIVE TUBES OF THE "VIDICON" TYPE.

Ya.A.Oksman and M.V.Epifanov.

Radiotekhnika i Elektronika, Vol. 3, No. 12, 1501-15 (1959). In Russian.

Lag in photo-resistive tubes is generally ascribed to incomplete discharge of a picture element by the electron beam and photoelectric relaxation in the target material. An experimental and theoretical study of the effect is carried out. It is shown that the target can be represented by an equivalent circuit consisting of a two-stage RC network. The experimental results indicate that transient processes in photo-resistive tubes can be explained if it is assumed that the high-resistance layer of the semiconductor contains a space charge, the size of which depends on the illumination, and that the life-time of the carriers is shorter than the time of establishment of diffusion-drift equilibrium. [English summary: PB141106T-11 obtainable from Office of Technical Services, U.S. Department of Commerce, Washington, D.C., U.S.A.]. R.C.Glass

621.397.331.24 : 535.37

2549 PHOTOSENSITIZATION OF PHOSPHOR LAYERS. I.Bornemann.

Exper. Tech. der Phys., Vol. 7, No. 3, 126-34 (1959). In German.

The photo-resist technique, using an alkali bichromate and a soluble colloid (polyvinyl alcohol), is described in its application to three-colour screens on cathode-ray tubes. Photomicrographs are shown of different stages, some faulty and some successful. S.T.Henderson

621.397.335

2550 SYNCHRONIZATION OF TELEVISION WAVEFORM CENTRES. H.Windischbauer.

Elektronik, Vol. 8, No. 8, 233-7 (Aug., 1959). In German.

A brief engineering survey of various present-day techniques of sync. pulse locking, stripping, generating (locally) and re-inserting, illustrated by very generalized block diagrams. The appended bibliography quotes mainly patents. A.Landman

621.397.335

2551 TIME-BASE SYNCHRONIZATION AND ASSOCIATED PROBLEMS. P.L.Mothersole.

J. Brit. Instn Radio Engrs, Vol. 20, No. 1, 57-72 (Jan., 1960).

The definition and quality of a television picture is determined by the effectiveness of the time-base synchronization when the receiver is used in a noisy situation. The requirements of the synchronizing and time-base oscillator circuits for use with both positive and negative modulation systems are described. Circuit techniques are surveyed to show the difference in approach due to the sense of the video modulation.

621.397.335

2552 NOISE-CANCELLED SYNCHRONISING-PULSE SEPARATOR CIRCUIT FOR 525- AND 625-LINE TELEVISION RECEIVERS. P.L.Mothersole.

Mullard tech. Commun., Vol. 5, 13-16 (Dec., 1959).

The effect of noise pulses on the synchronizing-pulse separator is discussed. From this discussion it follows that to obtain stable timebase synchronization with negative vision modulation, noise-protection must be provided, and a simple noise-inverting circuit is described. The complete circuit developed for an experimental receiver, consisting of a noise-inverter preceding the a.g.c. circuit and individual frame- and line-pulse separators, is also described. The bias for the noise inverter follows automatically changes in signal strength and contrast-control settings, so that optimum results are obtained over a wide range of signal inputs.

621.397.6

2553 A TELEVISION MASTER SWITCHER. B.Marsden.

J. Brit. Instn Radio Engrs, Vol. 20, No. 1, 47-54 (Jan., 1960).

A survey is made of standard methods at present in use for switching video signals: mechanical switches, electromechanical relays, and systems using thermionic relays. A method of video selection is then described in which the switch elements are made up of semiconductor diodes. Both master control room and studio type switches are discussed. Reference is made to development work in which transistorized pulse generators are being used to achieve vision switching between successive frames of the television waveform.

621.397.61 : 621.311.61

2554 A D.C./SINE-WAVE PORTABLE POWER SUPPLY USING SOLID-STATE TECHNIQUES. D.P.Gregg.

J. Soc. Motion Picture Televis. Engrs, Vol. 68, No. 10, 693-6 (Oct., 1959).

States the disadvantages of vibrator and rotary inverters used to drive professional cameras and sound recording gear, and describes a superior battery-operated transistor inverter. The choice of a sine-wave output is explained, and a load table shows a rating requirement of 200 W continuously, with 500-600 W momentarily for motor starting. The design of the oscillator, amplifier and regulating circuits is outlined briefly, and the protective circuitry and cooling methods are described more fully, with reference to the operating conditions. Efficiency figures are derived, the advantages of motor power-factor correction are explained, and the battery requirements specified. E.F.Hansford

621.397.61

2555 A HIGH-GRADE INDUSTRIAL TELEVISION CHANNEL WITH REFERENCE TO INFRA-RED OPERATION. J.H.Taylor.

J. Brit. Instn Radio Engrs, Vol. 77-85 (Jan. 1, 1960).

The range and scope of the uses of television for industrial purposes are indicated to give some of the design requirements and

to show broadly how they have been met with reference to a particular television channel employing a vidicon camera tube. In addition, two special applications are described, namely the use of this channel with infrared and ultraviolet light.

621.397.61

2556 GAMMA RADIATION INSENSITIVE TELEVISION CAMERA LENSES. J.D.Hayes.

J. Soc. Motion Picture Televis. Engrs, Vol. 68, No. 12, 816-18 (Dec., 1959).

Vidicon and image-orthicon types of television camera lenses have been designed to utilize only those "non-browning" optical glasses especially developed to maintain their transparency in gamma-radiation fields. The optical and mechanical characteristics of these lenses as well as the performance test data are described.

621.397.62 : 621.396.66

ONE-TUBE OSCILLATOR MIXERS FOR TV AND F-M TUNERS. See Abstr. 2500

621.397.9

2557 CLOSED-CIRCUIT TELEVISION IN SCHOOL AND COMMUNITY: THE CHELSEA PROJECT. L.Creshkoff.

J. Soc. Motion Picture Televis. Engrs, Vol. 68, No. 11, 764-8 (Nov., 1959).

621.397.9

2558 FACTORS EFFECTING CONTRAST AND RESOLUTION IN THE SCANNING ELECTRON MICROSCOPE. T.E.Everhart, O.C.Wells and C.W.Oatley.

J. Electronics and Control, Vol. 7, No. 2, 97-111 (Aug., 1959).

Experiments have been made to clarify the factors which cause the image produced by secondary electrons (energy below 50 eV) to differ markedly from that produced by reflected electrons of higher energy. The latter can reach the collector only along a straight line path, but the former are not so limited and therefore show far more detail from a rough surface. The secondary electron image also has higher contrast. The influence of the variation in angle between primary electron beam and specimen surface, local topography and potential variations across the surface are discussed and illustrated with micrographs. The broadening of the primary beam by scattering as it penetrates the specimen is shown to become important only for a spot size below 100 A. A more important limitation on resolution may be imposed by variations in the secondary emission coefficient, a factor not previously taken into account. It is concluded that a resolution better than 100 A may still be attainable, if a small field of view and a small number of contrast steps can be accepted. V.E.Cosslett

CONTROL . DATA PROCESSING

CONTROL AND SERVO SYSTEMS

621-52

2559 REPRESENTATION OF REGULATING CIRCUITS BY BLOCK AND STRUCTURE DIAGRAMS. E.Krochmann.

A.E.G. Mitt., Vol. 49, No. 1, 46-56 (Jan., 1959). In German.

The method of converting a schematic system diagram to a block diagram is reviewed, and an example of speed control is studied. Further breakdown into elementary block (structure diagrams) is explained and rules are given for the direct conversion of electrical and mechanical systems. The representation of differential equations is also described. W.G.Stripp

621-52

2560 UNISELECTORS ENTER AUTOMATIC PROGRAMME CONTROL. II. H.Law.

Control, Vol. 2, No. 16, 93-7 (Oct., 1959).

Methods of uniselector programming for rolling-mill operation are given in Abstr. 1918 of 1960. The actual arrangements in a steel rolling-mill automatic programme control system are here discussed. Sensing instruments, reference and comparator circuits, digital to analogue conversion and power amplification are dealt with. The advantages of programming the operations are pointed out. T.Horrocks

621-52

2561 MULTIPLEX CIRCUITS FOR CONTROL OF A ROBOT. D.A.Campbell.

Electronics, Vol. 33, No. 4, 46-8 (Jan. 22, 1960).

A system is described for the control of a robot where there would be risk to a human operator. Digital control and time-division multiplexing are used. Multiplexing is achieved by using two synchronized 54-position switches. The principal limitation is imposed by the capacitance of the long control cable between the commutating switches. T.Horrocks

621-52 : 669

2562 TWO EMISSION STABILIZERS FOR ELECTRON-BOMBARDMENT FURNACES. D.Allenden.

J. sci. Instrum., Vol. 36, No. 2, 66-70 (Feb., 1959).

Stabilization requirements and techniques for electron-bombardment heating are considered, and basic design formulae are presented for a flexible control system applicable to temperature-limited emission furnaces. Power handling capacity, loop stability and speed of response are discussed, and full circuit details of practical stabilization systems for a 250 W and a 6 kW furnace are given. It is concluded that emission stabilization is always beneficial, and sometimes essential, and that emission stabilities of better than 0.5% at powers up to 20 kW are practicable.

621-52 : 621.313.32

2563 THE STATIC STABILITY OF THE AUTOMATIC CONTROL OF A SELF-EXCITED SYNCHRONOUS GENERATOR WITH VARIABLE FREQUENCY. E.Yakubaitis.

Latv. PSR Zinat. Akad. Vestis, No. 8(145), 39-46 (1959). In Russian.

Writes the differential equations for the inertialess metering device, for the transistor fed from the metering device, and for the synchronous generator, to the excitation winding of which the transistor is connected. The effect of the self-excitation circuit on the control circuit is considered and inequalities are obtained which need to be satisfied for the system to be stable when the excitation winding is fed from the armature. Feed of the self-excitation winding from the stator worsens the stability of the automatic control system as a whole. D.E.Brown

621-52

2564 A PRACTICAL STANDARD TRANSISTORIZED OPTIMUM RESPONSE CONTROLLER. K.Chen and D.R.Little.

Trans. Amer. Inst. Elect. Engrs II, Vol. 78, 337-45 (1959) = Applic. and Industr., No. 45 (Nov., 1959).

This controller can work in a great variety of feedback systems because it has negligible time delay. Optimum response to a specified step input can be obtained very easily by experiment because linear switching is used. The response is still nearly optimum when the input is not of the specified form and magnitude, or when the system parameters change with environmental variations. Solution of practical problems in the development are discussed. A mathematical proof is given to show that optimum response to a specified step input, for the systems under consideration, can always be obtained with linear switching.

621-526

2565 THE DESIGN OF POSITION AND VELOCITY SERVOS FOR MULTIPLYING AND FUNCTION GENERATION. E.O.Gilbert.

I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 391-9 (Sept., 1959).

The important characteristics of potentiometers, gear train, motor, amplifier and tachometer are defined and discussed. Nonlinear performance requirement, such as velocity and acceleration limits, overshoot for large step inputs, and static resolution, are defined in terms of component parameters. A minimum gear reduction ratio is determined on the basis of acceleration, frictional torque ratio, overshoot for large step inputs, or static resolution. Linear system analysis is made and related to system components and nonlinear performance; in particular, it is shown that static resolution is limited by servo amplifier bandwidth for given motor, potentiometers, and gear train. The selection of damping methods and the reduction of steady-state errors is described. An example design is considered.

621-526

2566 ADAPTIVE SERVOMECHANISMS. C.W.Johnson.

I.R.E. Trans Med. Electronics, Vol. ME-6, No. 3, 134-40 (Sept., 1959).

Several categories of adaptive systems are discussed and an attempt is made to associate the operating principle of the systems in each category with the behaviour of the human being when he acts as a controlling device. A particular system developed for application in the field of automatic flight control is discussed from a functional point of view. The controller, using an analogue model which operates on the input information, determines a "standard of performance" for the controlled element which closely approximates the performance desired by an experienced operator. The remainder of the controller, using a very simple passive network as a switching function computer to determine the state of a bistable device, forces the controlled element to operate in such a manner as to minimize continuously the error between the desired performance and the actual performance. The controller exhibits adaptive behaviour in the sense that it operates in such a manner as to keep the actual performance of the system practically invariant, although the parameters of the controlled element change over a relatively wide range of values.

621-526

2567 USE OF RESOLVERS OPERATING AT 10 kc/s AS INPUT DEVICES FOR INDUCTOSYN MACHINE-TOOL POSITIONING SYSTEMS. E.J.C.Fowell.

Muirhead Tech., Vol. 14, No. 1, 3-6 (Jan., 1960).

Tests at 10 kc/s on standard resolvers showed that the errors were little greater than at the nominal test frequency of 1 kc/s, and that the overall input system error of a feedback positioning system using 2 resolvers and an Inductosyn should be of the order of 5×10^{-6} in. A.O.Stanesby

TELECONTROL . TELEMETERING

621.398

2568 A.I.E.E. TELEMETERING, SUPERVISORY SYSTEMS, AND ASSOCIATED CHANNELS. 1959 REPORT. VOLUME I. PART I, TELEMETERING. PART 2, SUPERVISORY SYSTEMS. PART 3, BIBLIOGRAPHY.

New York: The American Institute of Electrical Engineers (June, 1959) 8-111, 71 pp.

Part 1 covers definitions, applications, types and characteristics of systems and the selection of a particular system. Part 2 deals with performance of functions over supervisory systems, coding, single- and multi-station operation, power requirements, physical construction and channel arrangements and monitoring. Part 3 consists of bibliography covering the period 1912 to 1958 and containing approximately 1500 references. Volume II, containing Part 4 (Associated Channels) is to be published later.

621.398 : 621 396.2

2569 PULSE-CODED FAULT ALARM IN MICROWAVE SYSTEMS. J.B.Bullock.

Electronics, Vol. 33, No. 1, 82-4 (Jan. 1, 1960).

Outlines the circuit principles used for coding and decoding for a supervisory system capable of handling up to 256 conditions by binary-coding the length of 8 pulses of tone or d.c., transmitted cyclically over the supervisory channel. F.F.Roberts

621.398 : 621.316.95

2570 HOW RADIATION MONITOR GUARDS NUCLEAR NAVY. H.E.DeBolt.

Electronics, Vol. 33, No. 4, 43-5 (Jan. 22, 1960).

A transistorized radiation monitor and alarm system to indicate when alpha and beta radiation in air reaches preset level. Sensitivity is in the range 8×10^{-8} to 8×10^{-7} microcuries per cm^3. Calibration and age variation of equipment are checked by the known radiation level of Sr^{90} in the detector. A.J.Ingels

621.398 : 621.311.42

2571 TELECONTROL OF TRANSFORMER SUBSTATIONS. F.Bernstrim.

E.R.A. (Stockholm), Vol. 32, No. 8, 88-91 (1959). In Swedish.

The supply district of the Alvkarleby power station of Stockholm installed nine 77/22 kV transformer substations early in 1959, and increasing load will require more still. A central control-room in Stockholm is connected via multichannel cable to a central transmitting aerial outside the town whence radio links connect to all individual substation. The number of functions to be transmitted to each controlled substations varies from 30 to 70. The greatest link distance is 60 km. The frequencies used were in the 160 Mc/s and 400 Mc/s bands, the lower being used when the transmission distances exceed 30 km. The layout of the control room, the transmission system and operational experience are discussed. G.N.J.Beck

621.398 : 621.311.23

REMOTELY CONTROLLED POWER STATION. See Abstr. 2003

621.398

2572 UNIVERSAL TRANSISTORISED SIGNALLING SYSTEM. N.N.Barkov and V.I.Dronov.

Energetik (Moscow), 1959, No. 12, 1-4. In Russian.

After explaining briefly the obvious advantages of electronic signalling equipment in comparison with kinematic linkages (versatility, flexibility, minimal power requirements, response speed etc.), a simple basic amplifier-control unit is described, consisting of a single transistor, type P3, with Ic max = 200 m A with a relay winding as collector load. The transistor is used as a switch, a contact electrode being operated by the controlled medium, to open or close the base supply circuit, thus turning the transistor on and energizing the relay. Circuit diagrams of the following equipments are reproduced and briefly described: (1) liquid level control; (2) gradual control of pumping processes by means of a floating electrode operating the base bias potentiometer; (3) use of contact of varying immersion depth for bunkering of solid fuel; (4) push-pull arrangements, for instantaneously-operating polarized relays; and (5) for min. and max. level controls. A.Landman

621.398

2573 A ROD-POSITION INDICATION SYSTEM FOR PRESSURIZED REACTORS. R.C.Floyd and J.F.Reuther.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 614-18 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

Describes a system for indicating control-rod position by detecting the position of magnetic material in an extension to the control rod. A detecting coil forms part of an Owen bridge and movements of the control rod are manifest as an out-of-balance bridge current. The equipment is designed to function over a wide range of temperature, mains voltage and frequency. A.E.I. Research Laboratory

621.398 : 621.374.32

DATA CONVERSION CIRCUITS FOR EARTH SATELLITE TELEMETRY. See Abstr. 2289

COMPUTERS . APPLICATIONS

(Refer also to Digital circuits . Switching circuits)

681.142

2574 SELF-CHECKING METHODS IN ELECTRONIC CALCULATING MACHINES. F.Rausch.

Elektron. Rdsch., Vol. 13, No. 6, 206-10 (June, 1959). In German.

After a brief discussion of programmed checks the question of built-in checking circuits is examined. For error-detecting codes it is necessary for each character to differ in at least two bits from all others, and five bits are thus needed for a decimal code. For an error-correcting code at least three bits must differ and seven bits are needed to represent a decimal character; such a code can also be used to detect two errors. As examples the self-checking 2-out-of-5 and the biquinary codes are developed and logical diagrams given for various error-detecting circuits. G.A.Montgomerie

681.142

2575 A LOGIC DESIGN FOR A MICROWAVE COMPUTER. S.P.Frankel.

I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 271-6 (Sept., 1959).

The properties of presently available components place special emphasis on two desiderata of logic design for use in a microwave

digital computer: (1) smallness of the number of active elements; (2) elimination of information-cycling paths having delay times comparable or short compared with the bit period, as in the conventional flip-flop. A logic design developed in response to these pressures is described in substantially complete detail. Property (1) is obtained by the use throughout of a multiplexing procedure such that the computer functionally (although not physically) resembles a number of nearly identical, and correspondingly slower, computers which are able to operate either independently or in concert.

681.142

2576 A NOTE ON ERROR DETECTION IN NOISY LOGICAL COMPUTERS. M.Eden.
Information and Control, Vol. 2, No. 3, 310-13 (Sept., 1959).

The method of error detection is proposed which extends the range of the propositional variables so that residue class check symbols may be used in error detection. The principal consequence is that individual logical elements may be designed to process binary inputs with arbitrary reliability and nonzero channel capacity.

681.142 : 621.374.32

2577 THE PARAMETRON DIGITAL COMPUTER MUSASINO-1. S.Muroga and K.Takashima.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 308-16 (Sept., 1959).

The features of a large-scale digital computer with novel logical elements called parametrons, are described. The machine is named the Musasino-1, and has been in almost continuous operation since its completion in the spring of 1957. Arithmetic operations are carried out in parallel, and a rapid access ferrite-core memory is used. Maintenance experience has indicated its extreme stability and low incidence of faults. For full description (in Japanese), see Abstr. 2284-6 (1959).

681.142 : 621.374.32

2578 AN IDEALIZED OVER-ALL ERROR-CORRECTING DIGITAL COMPUTER HAVING ONLY AN ERROR-DETECTING COMBINATIONAL PART. W.L.Kilmer.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 321-5 (Sept., 1959).

The block diagram of an idealized overall error-correcting digital computer is presented. This computer has the property that during each unit time interval, it can correct the effects of a specific maximum number of transient-type component failures which might occur anywhere within it. All its combinational logic circuitry is only of the error-detecting type. The corresponding reduction in equipment is achieved at the expense of the computer's having to sit idle during a large percentage of those time intervals in which component failures occur. In a sense, therefore, the computer utilizes a great deal of time-domain redundancy as well as equipment-domain redundancy. Some of the design requirements that are involved in using this type of redundancy structure are discussed.

681.142

2579 THE CORDIC TRIGONOMETRIC COMPUTING TECHNIQUE. J.E.Volder.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 330-4 (Sept., 1959).

The COordinate Rotation Digital Computer (CORDIC) is a special-purpose digital computer for real-time airborne computation. A unique computing technique is employed which is especially suitable for solving the trigonometric relationships involved in plane coordinate rotation and conversion from rectangular to polar coordinates. CORDIC is an entire-transfer computer; it contains a special serial arithmetic unit consisting of three shift-registers, three adder-subtractors, and special interconnections. By use of a prescribed sequence of conditional additions or subtractions, the CORDIC arithmetic unit can be controlled to solve either set of the following equations:

$$Y' = K(Y\cos\lambda + X\sin\lambda)$$
$$X' = K(X\cos\lambda - Y\sin\lambda),$$

or

$$R = K\sqrt{X^2 + Y^2},$$
$$\theta = \tan^{-1} Y/X,$$

where K is an invariable constant. This special arithmetic unit is also suitable for other computations such as multiplication, division, and the conversion between binary and mixed radix number systems. However, only the trigonometric algorithms used in this computer and the instrumentation of these algorithms are discussed.

681.142

2580 DECIMAL–BINARY CONVERSIONS IN CORDIC. D.H.Daggett.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 335-9 (Sept., 1959).

The CORDIC computer (see preceding abstract) contains a unique arithmetic unit composed of three shift registers, three adder-subtractors, and suitable interconnections for efficiently performing calculations involving trigonometric functions. A technique is formulated for using CORDIC arithmetic unit to convert between angles expressed in degrees and minutes in the 8, 4, 2, 1 code and angles expressed in binary fractions of a half revolution. Decimal-to-binary conversion is accomplished through the generation of an intermediate binary code in which the variable values are +1 and −1. Each of these intermediate code variables controls the addition or subtraction of a particular binary constant in the formation of an accumulated sum which represents the angle. Examples are presented to illustrate the technique. Binary-to-decimal conversion is accomplished by applying essentially the same conversion steps in reverse order, but this feature is not discussed fully. Fundamental principles of the conversion technique, rather than details of implementation, are emphasized. The CORDIC conversion technique is sufficiently general to be applied to decimal–binary conversion problems involving other mixed radix systems and other decimal codes.

681.142

2581 LOGICAL MACHINE DESIGN II: A SELECTED BIBLIOGRAPHY. D.B.Netherwood.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 367-80 (Sept., 1959).

For Pt I, see Abstr. 5905 (1958). This second part extends the total number of references given to 777. An alphabetical subject index is also provided. The bibliography which appeared in the June, 1958, issue of these Transactions is extended to a total of 777 titles. The original format is retained, but in this supplement the scope of material is restricted to technical publications pertaining to the logical design of machines.

681.142

2582 STATISTICS APPLIED TO COMPUTER CIRCUIT DESIGN. E.U.Cohler.
Sylvania Technol, Vol. 12, No. 4, 134-9 (Oct., 1959).

681.142 : 621.395.625.3

FACTORS INFLUENCING THE APPLICATIONS OF MAGNETIC TAPE RECORDING TO DIGITAL COMPUTERS. See Abstr. 2484

681.142 : 621.395.625.3

HIGH-DENSITY FILE DRUM AS A COMPUTER STORE. See Abstr. 2487

681.142 : 621.395.625.3

MAGNETIC FILM FILE FOR COMPUTER STORAGE. See Abstr. 2486

681.142 : 621.395.625.3

MAGNETIC DISK, RANDOM ACCESS MEMORY. See Abstr. 2485

681.142 : 621.374.32

HIGH-SPEED DIGITAL STORAGE USING CYLINDRICAL MAGNETIC FILMS. See Abstr. 2299

681.142 : 621.382.2

SEMICONDUCTOR PARAMETRIC DIODES IN MICROWAVE COMPUTERS. See Abstr. 2379

681.142

2583 SOLID-STATE DIGITAL CODE-TO-CODE CONVERTER. R.Wasserman and W.Nutting.
Electronics, Vol. 32, No. 50, 60-3 (Dec. 11, 1959).

An angular shaft-position indication is given by a coded disk operating in the Gray (cyclic-binary) code and having 13 tracks. The convertor described displays the shaft position upon 13 visual binary indicators, but in pure binary code. The primary element of the conversion circuit is a rectangular hysteresis loop magnetic core combined with a transistor and delay line, and is used to perform various functions in a counter, a shift register and in logical decision. The cyclic digits are set into a shift register from which they are shifted, bit by bit, the most significant first, into the convertor, the converted digits being put back into the shift register as

they are produced. After 13 shift pulses the conversion is complete and a final pulse causes the result to be displayed on the indicators, each conversion taking about 10 msecs. G.H.Stearman

681.142 : 621.396.96

2584 REAL-TIME DATA TRANSMISSION SYSTEM. C.R.Scott and W.H.Butler.

I.R.E. Trans Commun. Syst., Vol. CS-7, No. 3, 201-5 (Sept., 1959).

This system was designed for and installed at the Atlantic Missile Range. It is used to transmit the digital range, azimuth, and elevation coordinates from remotely located radars into the Range Safety IBM 704 Computer at Cape Canaveral, Fla. The radar data is transmitted at a rate of 10 pulses/sec and is used in the computation of a predicted impact point ten times a second within the computer. The predicted impact point is displayed on vertical plotting boards for use by the Range Safety Officer.

681.142 : 621.398

2585 HIGH-SPEED PLOTTING OF TELEMETERING DATA. R.L.Sapirstein.

Electronics, Vol. 33, No. 2, 41-3 (Jan. 8, 1960).

The computed results from a telemetry system appear as digital signals upon magnetic tape. The purpose of the equipment described is to plot these results rapidly on paper together with alphanumeric characters used to describe the events occuring in the system under test. The recorder employs an electrolytically marked paper and a row of 1024 styli which are pulsed as required. The paper is normally blank initially and the computer tape contains the information necessary to fulfil the following functions: - marking both transverse and longitudinal graticule lines, writing appropriate scales against these; inserting alpha-numeric characters; plotting up to 40 independent curves, both abcissae and ordinates being under control of the tape. Characters are programmed into a matrix of dots within the computer. The principles of the decoding and control circuits are briefly described. G.H.Stearman

681.142

2586 ELECTRONIC DATA-PROCESSING SYSTEMS FOR AMERICAN BUSINESS. J.C.Hammerton.

Electronic Engng, Vol. 32, 148-54 (March, 1960).

An attempt is made to outline the basic requirements of such systems as they now appear; due attention being paid to the areas of agreement and controversy among the various equipment manufacturers. Related engineering problems and programming requirements and methods are also discussed.

681.142

2587 STEEL OPENS THREE DOORS TO AUTOMATIC DATA PROCESSING. R.M.Sills and G.E.Terwilliger.

Control Engng, Vol. 6, No. 12, 99-104 (Dec., 1959).

As an example of the place which data processing can take in the steel industry, the production of electrolytic tinplate from ore is outlined. Data processing can first be used to mechanize the great amount of information handling associated with various parts of the process; secondly, by means of automatic data logging, a finer check can be made of the efficiency of the processes; finally, closed-loop control can be applied to actual operations. This last stage is described as applied to a cold reduction mill. G.A.Montgomerie

681.142

2588 PROCESSING NEUROELECTRIC DATA. Communications Biophysics Group of Research Laboratory of Electronics and W.M.Siebert.

Cambridge (Massachusetts): Technology Press of the Massachusetts Institute of Technology (1959) vii + 121 pp. [Technology Press Research Monographs].

This monograph brings together the recent thoughts of the authors on processing the electrical data they record from the nervous system. The first of the three main chapters deals with the quantification of neuroelectric activity and covers the philosophical problems of measurement and analysis in electrophysiology and puts forward a statistical view of neuroelectric phenomena. The second chapter is concerned with evoked responses; several methods of analysis are discussed, and corresponding special-purpose computers (more fully described in an appendix) mentioned: ALMIDO (Amplitude and Latency Measuring Instrument with Digital Output) which measures and reports the latency of and the amplitude from the largest negative part of the greatest peak within a time period whose length and starting point delay after the stimulus can be preset at any value up to 30 ms; ERD (Evoked Response Detector) which is an analogue device enabling an average to be obtained of the amplitude of the response at any one preset delay time up to 185 ms after the largest positive to the stimulus (this is done by feeding in both stimulus and response from magnetic tape records, delaying the stimulus by a magnetic drum and using it to gate the response into an integrator; if another delay time is to be examined, the records must be fed through the machine, again); and ARC (Average Response Computer) which examines the response at up to 254 instants after each stimulus onset and outputs the result either as a histogram on a c.r.o. or on punched tape. This last machine is a special purpose digital computer using a magnetic-core memory which can be used, if necessary on-line, to compute histograms or alternatively an averaged response curve. The third chapter is concerned with electroencephalograms and discusses a technique in which the rhythmic burst activity is analysed by sampling, converting to digital form, and processing by the Lincoln Laboratory TX-0 computer. Autocorrelation and cross-correlation techniques are also considered and a variation of the ERD applied. The statistical techniques used are examined in other appendices. G.A.Montgomerie

681.142 : 621.374.32

2589 MANUAL CONTROL CIRCUITS FOR DATA PROCESSING SYSTEMS. P.M.Hall.

A.T.E. J., Vol. 15, No. 2, 173-86 (April, 1959).

Various input–output devices, such as punched cards, paper tape, and so on, are available for use with data processing systems, the choice depending on the application. Techniques for inserting data by means of manually operated keys and for controlling the system are described. Brief notes are included on methods of presenting stored data in the form of a visible display on lamps and indicators.

681.142

2590 THE USE OF AUTOMATIC PROGRAMING TECHNIQUES FOR SOLVING ENGINEERING PROBLEMS. J.T.Carleton, N.Chackan and T.W.Martin.

Trans Amer. Inst. Elect. Engrs I, Vol. 78, 596-601 (1959) = Commun. and Electronics, No. 45 (Nov., 1959).

A discussion, based on the use of three I.B.M. 704 and one I.B.M. 705 computers for making engineering calculations, at the Westinghouse Electric Corporation, of the most economical programming techniques. Unless very general programmes, constantly re-used for production runs, are involved it is very much better to use automatic programming techniques such as Fortran and this has the further advantage of enabling engineers to write their own programmes. The costs involved are given and there is an appendix describing the coding systems, and another one comparing them. Systems involved are SAP, FORTRAN, PRINT I, 705 SYMBOLIC and APS III. G.A.Montgomerie

681.142

2591 A CODE TRANSLATOR FOR LETTER-SORTING MACHINES. J.D.Andrews.

Proc. Instn Elect. Engrs, Paper 2957 E [International Convention on Transistors and Associated Semiconductor Devices], publ. May, 1959 (Part B Suppl. No. 16, 637-43, 698-701).

Republication, with discussion, of the paper abstracted in Abstr. 3624 (1959).

681.142 : 681.178.2

2592 NOVEL MAIL HANDLING MACHINES. H.Grunewald and W.Kach.

S.E.L. Nachr., Vol. 7, No. 2, 61-71 (1959).

Design and operation of two machines for handling automatically large volumes of letter mail are described. One machine (mail culling system) sorts the mail by size and then stacks letters and post cards. The other machine (letter facing system) turns the letters so stacked into a uniform position facing the operator.

681.142

2593 PATTERN DETECTION AND RECOGNITION. S.H.Unger.

Proc. Inst. Radio Engrs, Vol. 47, No. 10, 1737-52 (Oct., 1959).

Two types of pattern-processing problems are discussed. The first, termed "pattern detection", consists of examining an arbitrary set of figures and selecting those having some specified form. The second problem, "pattern recognition", consists of identifying a given figure which is known to belong to one of a finite set of classes. This is the problem encountered when reading alphanumeric characters. Both recognition and detection have been successfully carried out on an I.B.M. 704 computer which was programmed to simulate a spatial

computer (a stored-programme machine comprised of a master control unit directing a network of logical modules (see Abstr. 621 of 1959). One of the programmes tested consisted of a recognition process for reading hand-lettered sans-serif alphanumeric characters. This process permits large variations in the size, shape, and proportions of the input figures and can tolerate random noise when it is well scattered in small specks. Programmes for detecting L-shaped (or A-shaped) figures in the presence of other randomly drawn patterns have also been successfully tested.

681.142

2594 SOME APPLICATIONS OF A MEDIUM-SIZED DIGITAL COMPUTER TO POWER SYSTEM PROBLEMS.
J.G.Miles and M.N.John.
Metropolitan - Vickers Gaz., Vol. 30, 304-11 (Dec., 1959).

The M-V 950 Computer is described as it is used in routine calculations in an engineering office. Network load-flow and short-circuit study programmes are particularly referred to, and some future programmes are listed.

681.142 : 621.314.2

IMPULSE STRESSES IN TRANSFORMER WINDINGS. I-II. See Abstr. 2015

681.142 : 621.311.154

A NEW DIGITAL TRANSIENT STABILITY PROGRAMME. See Abstr. 1990

681.142 : 621.311.154

CALCULATION OF ECONOMIC LOAD DISTRIBUTION BY COMPUTERS. See Abstr. 1991

681.142 : 621.316.722

DISTRIBUTION SYSTEM PRIMARY-FEEDER VOLTAGE CONTROL. IV. A SUPPLEMENTARY COMPUTER PROGRAM FOR MAIN-CIRCUIT ANALYSIS. See Abstr. 2061

681.142 : 621.374.32

2595 A COMPUTER FOR THE CALCULATION OF POWER GENERATION COSTS. C.H.Wolff.
A.T.E. J., Vol. 15, No. 2, 187-201 (April, 1959).

Describes a small electronic digital computer which has been designed and built for the Central Electricity Generating Board. The calculations carried out are described, and some details of the design and construction of the computer are given.

681.142

2596 MINIMIZING THE NUMBER OF STATES IN INCOMPLETELY SPECIFIED SEQUENTIAL SWITCHING FUNCTIONS. M.C.Paull and S.H.Unger.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 356-7 (Sept., 1959).

Given a sequential switching function in the form of a flow table in which some of the entries are unspecified, the problem of reducing the number of rows in that flow table is extremely complex, and cannot, in general, be solved by any simple extension of the methods used for completely specified functions. An analysis of the problem is presented, and a partially enumerative solution is evolved. A rough indication of the efficiency of the given procedures may be obtained from the fact that these techniques have been successfully applied to approximately two dozen tables ranging up to about 15 rows. No solution required more than two hours.

681.142

2597 SYSTEM ORGANIZATION OF A MULTIPLE-COCKPIT DIGITAL OPERATIONAL FLIGHT TRAINER.
H.J.Gray, Jr, H.H.Nishino and A.L.Vivatson.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 326-30 (Sept., 1959).

Describes the system organization of a digital computer whose purpose is to activate simultaneously more than one cockpit of an operational flight trainer. The simulated aircraft are assumed to be all of the same type, but each is simulated independently. The computer is drum-sequenced and represents an application of the theory of multiple computers, since there are several different kinds of memories and more than one arithmetic unit in the system.

681.142

2598 COMPUTATION OF ELEMENTARY FUNCTIONS ON AN ELECTRONIC COMPUTER. P.Rabinowitz.
Bull. Res. Coun. Israel, Vol. 8F, No. 1, 63-5 (Sept., 1959).

The use of Newton's method facilitates the computation of elementary functions of double-precision numbers by enabling most of the computation to be done with single precision numbers, thus achieving a considerable gain in speed.

681.142

2599 PROGRAMMING FOR ELECTRONIC COMPUTATION OF STRESSES IN PIPING SYSTEMS. V.Coldham.
J. mech. Engng Sci., Vol. 1, No. 2, 93-102 (Sept., 1959).

Details are given of methods of calculation of thermal stresses and deflections in complex piping systems, suitable for use with a digital electronic computer. A resume of a working computer programme for multi-branch unconstrained systems is made, and a six-anchor three dimensional example solved automatically by this programme is described. Extension of matrix analysis for the more complicated constrained and looped layouts is developed in an appendix, where a method of interconnecting solutions of subsystems to give solutions of piping structures of very great complexity, is outlined.

681.142

2600 THE USE OF ELECTRONIC COMPUTERS TO AID IN MEDICAL DIAGNOSIS. R.S.Ledley and L.B.Lusted.
Proc. Inst. Radio Engrs, Vol. 47, No. 11, 1970-7 (Nov., 1959).

681.142

2601 ANALOG DIVISION CIRCUIT. W.McMurray.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 606-12 (1959) = Commun. and Electronics, No. 45, (Nov., 1959).

The device produces an alternating voltage output proportional to the quotient of two d.c. input signals. It consists of two identical cross-field reactors, an excitation transformer, an output transformer, and two independent d.c. input current controls. Additionally, if the excitation current is varied the output becomes proportional to this, and thus the circuit may also be used as a multiplier. Four-quandrant operation is possible. A complete theoretical description is given with circuit diagrams and performance curves.
K.C.Garner

681.142

2602 APPROXIMATION ERRORS IN DIODE FUNCTION-GENERATORS. N.Ream.
J. Electronics and Control, Vol. 7, No. 1, 83-96 (July, 1959).

Errors in electronic function-generators using biased diodes comprise (i) "electronic" errors due to amplifier drift, diode characteristics, etc., (ii) "approximation" errors resulting from fitting a piecewise-linear function to a smooth curve. Errors of type (ii) only are discussed here. It is shown how, using either of two obvious criteria for a "best" fit, the relationship between error and number of segments is obtained from a simple integral, to within the accuracy normally required in analogue-computer applications; the same integral is used to calculate the breakpoints between segments. Formulae and numerical results are given for some typical functions.

681.142 : 518.5

2603 SIMPLE ELECTRICAL ANALOGUE FOR THE SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS. D.B.Dove.
J. sci. Instrum., Vol. 36, No. 11, 474-5 (Nov., 1959).

A simple resistance analogue provides a rapid solution for simultaneous equations of the type $y_i = a_{ij}x_j$, where $a_{ij} = 0, i > j$.

681.142 : 518.5

2604 ANALOGUE COMPUTER FOR THE SOLUTION OF PRODUCT INTEGRALS. F.D.Penny and J.W.McHugo.
J. sci. Instrum., Vol. 36, No. 4, 173-9 (April, 1959).

The computer will accept up to three input variables simultaneously; they are presented in the form of recorder chart traces which are traversed mechanically, but are followed by hand. The instantaneous product of the input variables, or of some pre-selected function of them, is formed and charted. Mechanical integrators compute the integrals of each of the input variables and of the product. The particular arrangement described computes $\int ab\sqrt{c}\,dt$, $\int a\,dt$, $\int b\,dt$ and $\int\sqrt{c}\,dt$ where a(t), b(t) and c(t) are the input variables.

681.142

2605 A CIRCUIT FOR ELECTRICAL INTEGRATION AND DIFFERENTIATION OF PERIODIC FUNCTIONS.
W.Berger, F.Hövelmann and H.J.Kössler.
Elektron. Rdsch., Vol. 13, No. 9, 336-8 (Sept., 1959). In German.

Passive RC, Miller, and quasi-exact integrators are discussed, leading to a description of another active circuit having an integrating and a differentiating form. Basically this circuit is the simple

RC circuit used as the grid input to a pentode stage, the output of which is compensated by another passive single-order lag network, which if correctly matched to the input circuit provides an exact integration, (or differentiation if an appropriate input circuit is used with an inductance in the compensating circuit). The stage gain is allowed for by a shunt resistor in the output circuit. Accuracy within 1% is stated. An application to hysteresis measurement is described briefly. K.C.Garner

681.142 : 621.316.11

A DEVICE FOR SOLVING MUTUAL INDUCTION PROBLEMS ON A D.C. NETWORK ANALYZER. See Abstr. 2043

681.142

2606 MECHANICAL AND ELECTRICAL CIRCUITS WHICH ARE TOPOLOGICALLY EQUIVALENT. W.Reichardt.
Frequenz, Vol. 13, No. 9, 278–86 (Sept., 1959). In German.

Many mechanical problems can be usefully studied by setting up electrical analogues in which each element corresponds to a single property of the mechanical system. For this purpose, the analogues of current and voltage are force and velocity, respectively. Examples of this method of approach are given. V.G.Welsby

681.142

2607 OPERATIONAL ANALOG SIMULATION OF THE VIBRATION OF A BEAM AND A RECTANGULAR MULTICELLULAR STRUCTURE. A.B.Clymer.
I.R.E. Trans Electronic Comput., Vol. EC-8, No. 3, 381–91 (Sept., 1959).

A feasibility study of the use of an operational analogue computer for solution of structural problems was undertaken. A beam problem and a rectangular multicellular structure problem were run to test the method. It is shown that the method is highly competitive with digital computer and passive-element computer methods for solution of any structural problem.

681.142

2608 HOW ANALOG NETWORKS SOLVE AIR-CONDITIONING PROBLEMS. W.L.Wright and C.A.Booker.
Electronics, Vol. 32, No. 52, 34–7 (Dec. 25, 1959).

A specialized simulator is described which is designed specifically to provide an analogy of the thermal behaviour of a dwelling. Each component of the building, such as the ceiling, walls, windows etc., are simulated by special circuits which are scaled on a per unit area basis. Solar radiation is the programmed variable, and heat balance is provided by an air-conditioner system, which is also simulated. Circuits are illustrated together with a schematic diagram of the entire simulation. K.C.Garner

MECHANICAL AND CIVIL ENGINEERING TECHNOLOGY

MATERIALS . TESTING

620.172.22 : 539.4

2609 RESISTANCE STRAIN GAUGES OF LOW TEMPERATURE SENSITIVITY. G.R.Higson.
J. sci. Instrum., Vol. 36, No. 4, 157–9 (April, 1959).

Strain gauges manufactured from a series combination of Nichrome and Advance wires may be used in quarter-bridge circuits to measure static strains where the temperature is slowly varying. The average temperature drift corresponds to 20 lb/in^2 × deg C on steel and 2.5 lb/in^2 × deg C on dural and the sensitivity drop is less than 5% up to 250° C. When used in a full-bridge circuit the drift should be negligible.

620.172.224 : 621.315.616.9

2610 TESTING PLASTIC FILMS BY A STATIC-MECHANICAL METHOD. W.Voigt.
Arch. tech. Messen, No. 282 (Ref. V 91122-17), 145–8 (July, 1959). In German.

A pneumatically operated machine is described with which the mechanical properties of films under stress can be tested under the following conditions: with constant strain; with a constant rate of change of strain; with constant stress; with a constant rate of change of stress. C.F.Pizzey

620.179.14 : 621.317.49

2611 THE THEORY AND PRACTICE OF ELECTRONIC TESTING OF WINDING ROPES.
T.Harvey and H.W.Kruger.
Trans. S.African Inst. Elect. Engrs, Vol. 50, Pt 6, 126–82 (June, 1959).

Details are given of an electromagnetic testing unit for evaluating the condition of steel mine winding rope. It will discover defects either inherent in the rope or impressed upon it by such factors as defects in the winding plant (protruding rivets on the drum, bad grooving, badly profiled sheaves, etc.) or shaft system. An axial alternating current is induced in the rope by a magnetizing coil wound around it, and detected by a search coil wound close to the main coil. The two windings form a primitive transformer whose performance depends upon the steel core. Hysteresis losses are kept low by using a low magnetizing current, and eddy currents remain small because of the low frequency employed (normally 80 c/s). All ropes have a characteristic circular diagram under these conditions, and the detector circuit can distinguish between movement of the operating point around the circle or away from it, the latter movement being associated with variation of the cross-sectional area of the steel in the portion of the rope within the coil. The results given by this equipment have been correlated satisfactorily with those of the generally accepted mechanical tests. A.C.Whiffin

620.179.16 : 621.791

ULTRASONIC WELD TESTING MADE EASIER. See Abstr. 1965

620.193 : 621.315.2

2612 ON THE BEHAVIOUR OF "SEMICONDUCTING CORROSION COATINGS" UNDER THE INFLUENCE OF DIRECT CURRENT. E.Badum, J.Beckmann and R.Weintz.
F.u.G. Rdsch., No. 44, 149–55 (July, 1959). In German.

The method of operation and reasons for the "semiconducting corrosion coatings" on cables is described briefly. The failure of these coatings under stray direct current conditions is examined by subjecting sheet samples to low voltages under dilute electrolytes. The anodic oxidation of the carbon black or graphite fillings to carbon dioxide is shown to produce a porous film and hence failure of the protective coating. A modified salt bath test is described for examining protected cable samples. In the absence of stray direct current the coatings are satisfactory in very aggressive environs. The anodic breakdown of the coating occurs in moist conditions if a potential of 0.5 V to 2 V arises, i.e. the decomposition voltages possible in mineral salt solutions to be found in the soil. Illustrations of apparatus used and typical failures are given together with tabulated results. W.A.Walker

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 62 (1959). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Automat. Elect. tech. J.	Automatic Electric Technical Journal (Formerly: General Telephone Technical Journal [Gen. Teleph. tech. J.]) Automatic Electric Laboratories Inc., Northlake, Illinois.
B.B.C. Nachr.	B.B.C. Nachrichten Brown, Boveri und Cie, Mannheim.
Trav. Inst. Sci. Chérifien Ser. Sci. phys.	Travaux de l'Institut Scientifique Chérifien, Série Sciences Physiques. Société des Sciences Naturelles et Physiques du Maroc, Rabat. Publishers: Gauthier-Villars, 55 Quai des Grands-Augustins, Paris.

NEW JOURNAL

J. math. Phys. (New York).	Journal of Mathematical Physics. American Institute of Physics, 335 East 45th Street, New York 17, N.Y. Vol. 1, No. 1, dated January-February, 1960. Bi-monthly.

CHANGE OF TITLE

Gen. Teleph. tech. J.	General Telephone Technical Journal Title changed to: Automatic Electric Technical Journal [Automat. Elect. tech. J.] with issue dated February, 1960.

NOTE

The journal formerly quoted as "J. Math. and Phys." is now referenced as "J. Math. and Phys. (Cambridge, U.S.A.)".

ERRATA

Abstr. 1844 (1960) line 12: for "200 miles" read "2000 miles".
January 1960, p. 3, column 2: between Abstr. 31 and 32, the cross-reference should read "Remote controlled operation of substations. See Abstr. 542".
Author Index (January 1960): for "Obermaa,R.M.M." read "Oberman,R.M.M.".
Abstr. 3004 (1960): for a full version of this paper see Abstr. 1785 (1960).

AUTHOR INDEX

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